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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE
AMERICAN MACHINIST PUBLISHING CO.,
256 BROADWAY, NEW YORK.

Some Leading Articles in this Number.

What the Morse Taper Really Is and How It Was Measured.
Gas Engine Ignition.
An Example of Modern Fly-Wheel Construction.
Automatic Hub-Drilling Machines.
Strengthening Cast Iron by Vibrations.
Electromotive Force.
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NINETEENTH YEAR.

No. 20.
May 14,
1896.

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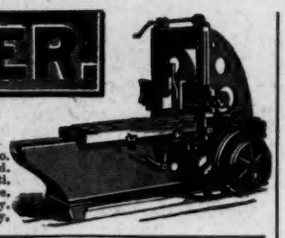

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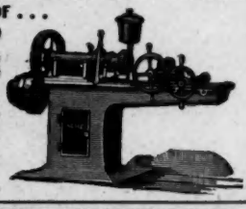

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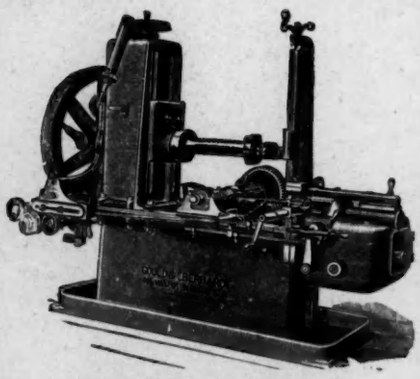

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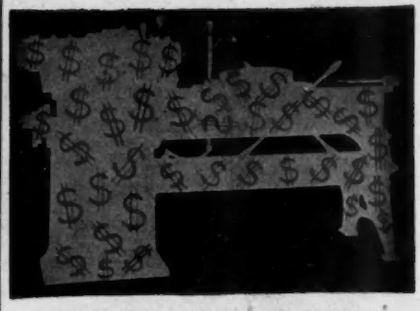

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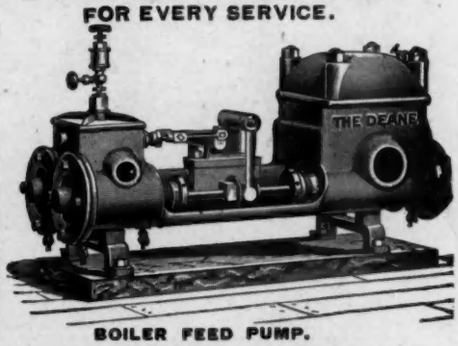

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NEW YORK, THURSDAY, MAY 14, 1896.

VOLUME 19. NUMBER 20.

What the Morse Taper Really Is and How It Was Measured.

What is known as the "Morse taper" is now so universally used for the shanks of drills and other tools that it is a matter of interest and importance to know just what it is. Until recently it was supposed that it was known just how much taper per foot each size of shank or Morse taper reamer had, and in our issue of November 29, 1884, we published drawings of six sizes of Morse taper shanks, and gave the taper per foot as follows:

No. 1, .604 inch per foot.
2, .6 " " "
3, .601 " " "
4, .615 " " "
5, .625 " " "
6, .634 " " "

Figured drawings for that publication were furnished by the Morse Twist Drill & Machine Company, and the figures as given were believed by all concerned to be correct, though the Pratt & Whitney Company publish in their catalog a table of "dimensions of the P. & W. Co.'s reamers for Morse standard taper socket," in which table the No. 1 and No. 3 shanks have .605 inch taper per foot, all other sizes as given in their table agreeing with those given in the table above.

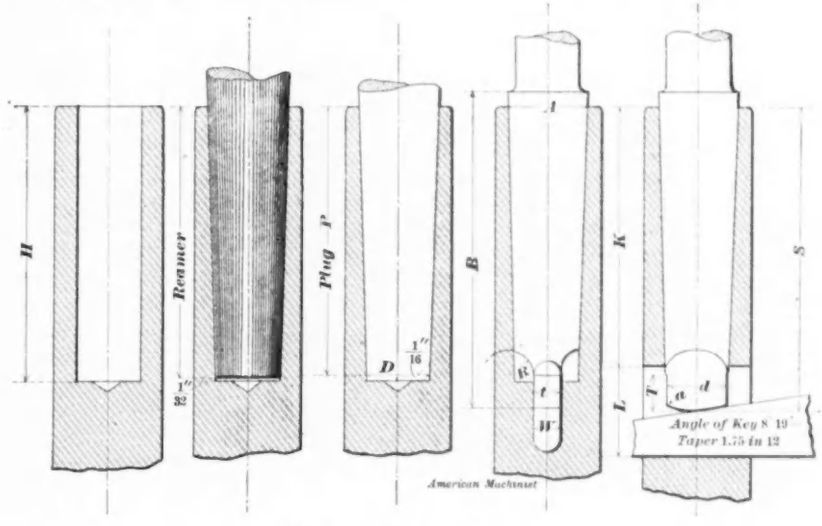
During a recent visit to the Morse Company's establishment, we found that they had been recently making a thorough investigation of this matter, with the result of finding that none of the previously determined figures were right, and that the tapers are in reality as given in Table No. 2, which, as will be seen, agrees neither with their own previous figures nor with those of the Pratt & Whitney Company.

The reason for this seemingly anomalous condition of affairs is to be found in the facts that the business of the Morse Company was started about 1864, when such means as are now common for producing accurate work, and for accurately measuring it when made, were not in existence. About 1871, however, a set of plug and ring gages were made in the Morse shops, which represented as nearly as possible the taper shanks then being made. Two sets of these gages were made —one for use in the shop, and the other kept under lock and key and used only as reference gages.

These plugs have, since that time, been the real standards for the Morse taper shanks, and that standard has not been departed from. The recent measurements have been made to determine their real taper per foot. Made before the days of universal grinding machines, and probably also ground immediately after hardening (in a lathe with emery-wheel attachment), they are now found to be not precisely round, true and uniform, though they stand the usual tests for such work very well.

The writer examined two of these original plugs—one made for the shop, and the other the reference plug for the same size. When tried in the ring with a very light streak of Prussian blue upon them, they both seemed to fit the ring accurately and to give every indication of being an excellent job. However, by the refined methods of testing adopted, these two plugs were clearly shown to differ from each other, and to be neither precisely round nor precisely uniform in taper from end to end; the error being of course very small, and in fact not discernible by ordinary tests.

The instrument used for measuring the tapers is shown by the accompanying reproduction of a working drawing of it, and consists of a cast frame *A*, to the front of which are secured two hardened and ground steel plates or straight-edges

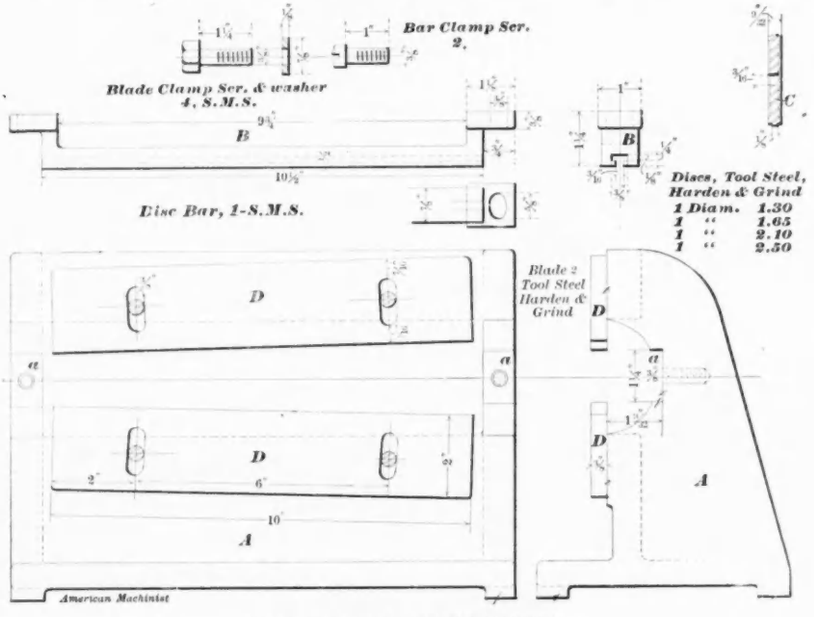


MORSE TAPERS—TABLE 2.

Number of Taper.	Diam. Plug at Small End.	Standard Plug Depth.	Depth of Hole.	End of Spin. to Key-way.	Length of Key-way.	Width of Key-way.	Length of Tongue	Diam. of Tongue.	Thickness of Tongue.	Rad. of Mill for Tongue.	Rad. of Tongue—a.	Shank Depth.	Whole Len. of Shank	Taper per foot.	Diam. at End of Socket.	Diam. of Point of Shank.	Taper per inch.
	D	P	H	K	L	W	T	d	t	R	a	S	B		A		
1	.369	2 1/8	2 3/16	2 1/16	3/4	.213	5/16	.33	13/64	3/16	.05	2 3/8	2 9/16	.600	.475	.356	.05
2	.572	2 9/16	2 5/8	2 1/2	7/8	.26	3/8	15/32	1/4	1/4	.06	2 7/8	3 1/16	.602	.7	.556	.05016
3	.778	3 1/16	3 1/4	3 1/16	1 1/16	.322	7/16	3/4	19/64	5/16	.08	3 1/16	3 3/4	.602	.938	.759	.05016
4	1.02	4 1/16	4 1/8	3 7/8	1 1/4	.478	1/2	59/64	25/64	3/8	.10	4 1/2	4 3/4	.623	1.231	.997	.05191
5	1.475	5 3/16	5 1/4	4 15/16	1 1/2	.635	5/8	1 9/32	31/64	1/2	.12	5 3/4	6	.630	1.748	1 446	.0525
6	2.116	7 1/4	7 3/8	7	1 3/4	.76	7/8	2	3/4	1/2	.15	8	8 5/16	.626	2.494	2 077	05216

with slotted holes, which allow them to be adjusted to or from each other, or to any desired angle or taper. The space between them is entirely unobstructed, and when placed on the bench in front of a window, so that a strong light shines through between them, the slightest opening between the straight-edges and a taper plug placed between them is made very apparent by the line of light that shows through.

At *B* is a bar adapted to be fastened to the frame *A* at *a*, and the bar is provided with a T-slot, as shown, by means of which steel disks, such as are shown at *C*, are fastened to it; and when two such disks are placed upon the bar, and the bar is in place upon the frame, the straight-edges *D D* and the disks are in the same plane. Having set the pieces



GAGE FOR MEASURING TAPERS.

D D to fit a taper plug, two suitable disks of different sizes are then placed upon the bar *B*, and adjusted upon it until they are each in contact with both of the straight-edges. The disks are ground true outside and to known diameters, so that a vernier caliper passed over outside of both of them as they remain fixed upon the bar, enables their true center-to-center distance to be determined, and from this and their known diameters the taper per foot represented by the opening between the straight-edges is readily determined by calculation. The reverse of this operation will, of course, enable one to set the straight-edges to any desired taper.

Extreme care was taken in arriving at the measurements given, and two careful experts measured each plug on two separate days, each man working independently of the other, and making all his own adjustments and measurements. The results of the four measurements of each plug agreed exactly; so that the belief is justified that the exact taper per foot is now known and is given in the table. The table also gives other dimensions of the Morse taper shanks, and, in fact, gives full information regarding them.

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Eight-Foot Radial Drilling Machine.

We give on the next page an engraving of a radial drilling machine made to drill to the center of a 16-foot circle.

The machine is of the stationary column type, having a saddle fitted to a guide, which is supported upon pivots at top and bottom and rests upon 34 steel balls 1-inch diameter. Attached to this guide is the arc shown, which passes through the column, turns with the guide, and can be locked in any desired position, to give the required lateral rigidity when drilling horizontally, or at an angle as shown by the engraving.

The arm has a vertical movement by power of 84 inches, and when in its highest position the end of spindle is 10 feet from the base. The spindle has 15-inch traverse, quick return, and is counterbalanced. Base is 169 x 73½ inches, 7½ inches deep, and the shipping weight of the tool is 22,500 pounds. It was built by the W. H. Warren Machine Tool Works, 98-100 Beacon street, Worcester, Mass.

▲ ▲ ▲

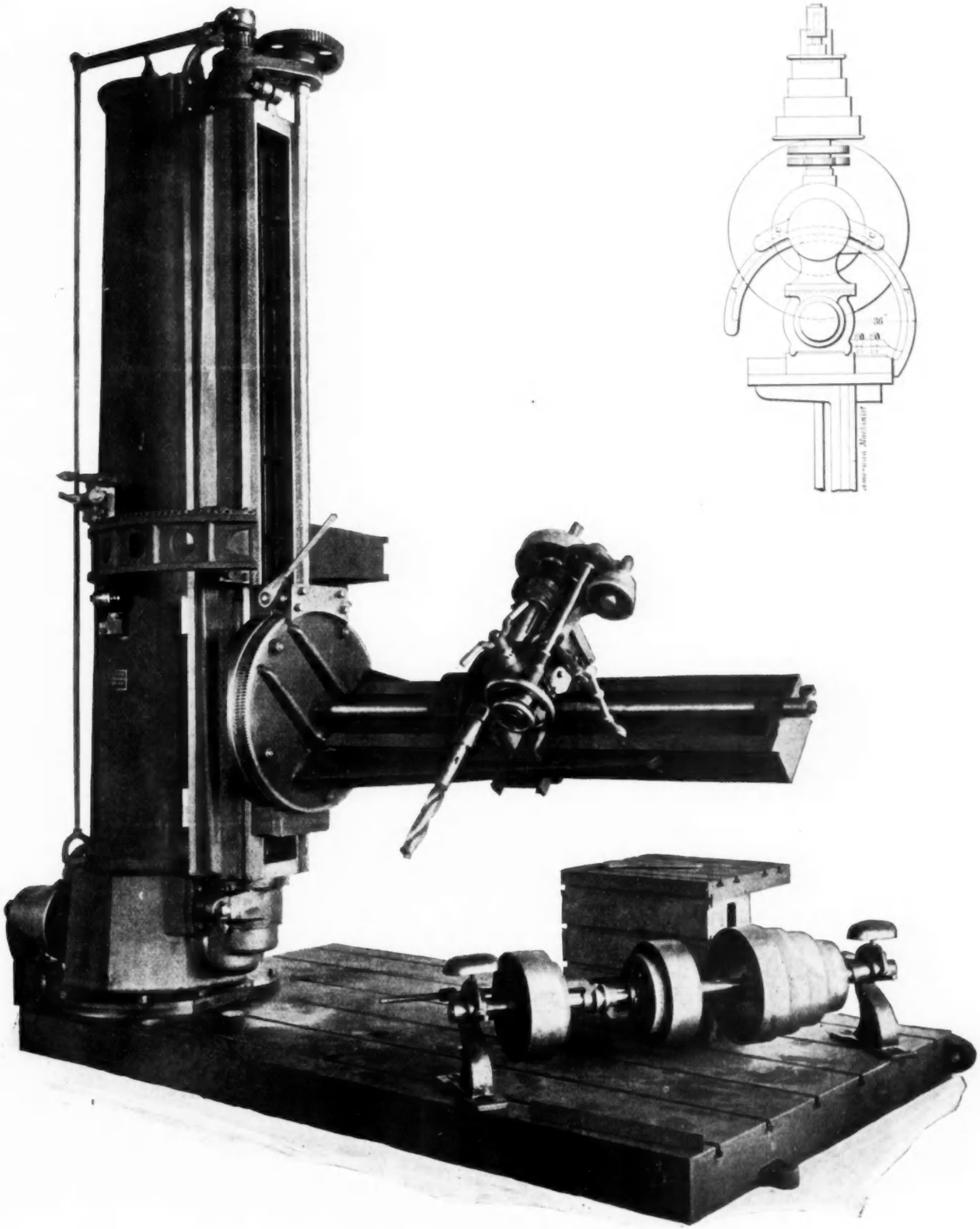
The managers of the Rhode Island State Fair are arranging for a race of horseless carriages and motocycles to be run on the Narragansett race course at Providence. Prizes to the amount of $5,000 will be awarded the successful competitors. The fair will be held September 7-11, and the rules and conditions that will govern have not yet been fully decided. The Rhode Island State Fair Association will manage the affair, and it is expected there will be a number of entries.

Gas Engine Ignition.

BY W. H. BOOTH.

In the very early days of the gas engine, the ignition of the explosive charge was performed by the indrawing action of the piston. A valve opened, there was less than atmospheric pressure in the cylinder because of the resistance of the gas and air indraft passages. Outside the cylinder was a flame, and when the ignition slide opened, the flame was carried into the cylinder with the rush of air. Then there was the original Otto engine, which employed a slide valve with a flame carried from an outside burner and communicated to the explosive mixture in the cylinder, the small carried flame keeping alight for the short period necessary for the valve to travel the minute distance between shutting off communication with the outside and opening communication with the inside of the cylinder. These valves were strictly on a time basis, and up to quite recent years even the Otto cycle engine has been made with a slide igniter. These valves were always becoming cut and scored by the hard carbon which formed on them, and the Otto people did a tremendous trade in facing-up valves and renewals. Our own engine had a couple of valves which were always on the move to and fro.

It was this heavy expense that led up to the ignition tube. This, as everyone knows, is simply a thick piece of tube about a quarter inch bore and nine inches long, or thereabouts. It is kept hot by a Bunsen flame inside an asbestos-lined chimney, and it causes the charge in the cylinder to explode at the proper time because the compressed explosive portion reaches the hot part of the tube at the right moment. It is easy to see how the regulation as to the exact point of time for ignition depends upon the length of tube, the ratio of compression and the heat of the Bunsen flame. Of course, the upper end of the tube contains burnt-out gas, the residue of old explosions; and this residual gas is compressed to the upper end of the tube, and allows the explosive gases to enter as far as the heated portion. The difficulty as to exact timing has, however, led to the use of so-called "timing valves," opened by a tappet and letting in the compressed gases to the hot tube just when required, so insuring explosion at the right moment. The original tubes used were of plain iron. They did not last long and were cheap. The heat inside and out oxidized them rapidly, and they usually ended by a split. All kinds of material have been tried for tubes to make them durable, and, so far as I can learn, only two are now in use. One I have tried, and I am about to try the other type. The two tubes are of very different material; one is metallic, the other mineral. The latter is of a white color; has a brilliant white, pearly, glossy fracture, like the finest porcelain, which



EIGHT-FOOT RADIAL DRILLING MACHINE.

indeed it much resembles. These tubes are made by the Indestructible Ignition Tube Co., of Queen Victoria street, London, and cost nearly two dollars each, but they will last one, two, or I believe even three years, often failing by being hit accidentally, for they are very brittle. An ordinary tube measures a quarter of an inch inside by nine-sixteenths outside diameter. The composition is, I am informed, a secret, but they have the appearance of being made of some porcelain-like material. They require careful handling.

The other tubes—the metal ones—are said to contain silver, but I should say this is due simply to their white and semi-silvery appearance. Apparently, they are an alloy of iron, but are not quite so hard, as they can be cut without difficulty with a penknife—that is, one can cut little shavings off them. More probably the alloy is one containing chromium. These tubes are long-lived; I have had them in a year without failure, and probably they will last longer. They will bend under the influence of the heat until they touch the sides of the asbestos-lined chimney or muffle, but you cannot break them by an accidental knock, and I do not know by whom they are made, unless it is the Stockport Engine Co. They cost the same as the porcelain tubes, and appear quite free from all tendency to oxidation, though I have known them fail by a split which is not visible on the cold tube.

The introduction of these non-oxodizable tubes has been a great boon to users of gas engines. Their high price (7s. 6d.), or nearly $2 is evidence of their superiority over plain iron tubes, which would fail at all sorts of inconvenient times, and could not be replaced and heated to working point under several minutes.

It is only of late that my attention has been more particularly directed to the methods of ignition in gas engines, and this may account for my knowing so little of the makers of the durable classes of tubes, which so far as I know, number two only. It is usually difficult to get information as to the composition of appliances of this nature. The making of the tubes is doubtless easy enough when the way is known, but has, I believe, involved considerable expense in experimenting.

▲ ▲ ▲

Load on Ball Bearings.

Mr. Jas. A. Morton, an engineer who has had much to do with ball bearings and is now connected with the Ball Bearing Co., of Boston, states that in his opinion no very closely defined rules can be given for proper loading of balls; but, speaking roughly, he would load a bearing with 10 to 15 pounds per ball where the balls are $\frac{3}{16}$ to $\frac{1}{4}$ inch diameter, and balls $\frac{1}{2}$ inch diameter may carry 20 to 30 pounds at moderate speeds and where the bearing is properly constructed.

Fly-Wheel Construction.

The repeated accidents with fly-wheels have caused renewed attention to be given to the construction of fly-wheel joints. Mr. H. M. Lane, of the Lane & Bodley Co., of Cincinnati, has called our attention to one error which is very often—perhaps usually—made in estimating the strength of the usual construction of joint with shrunk-on rings.

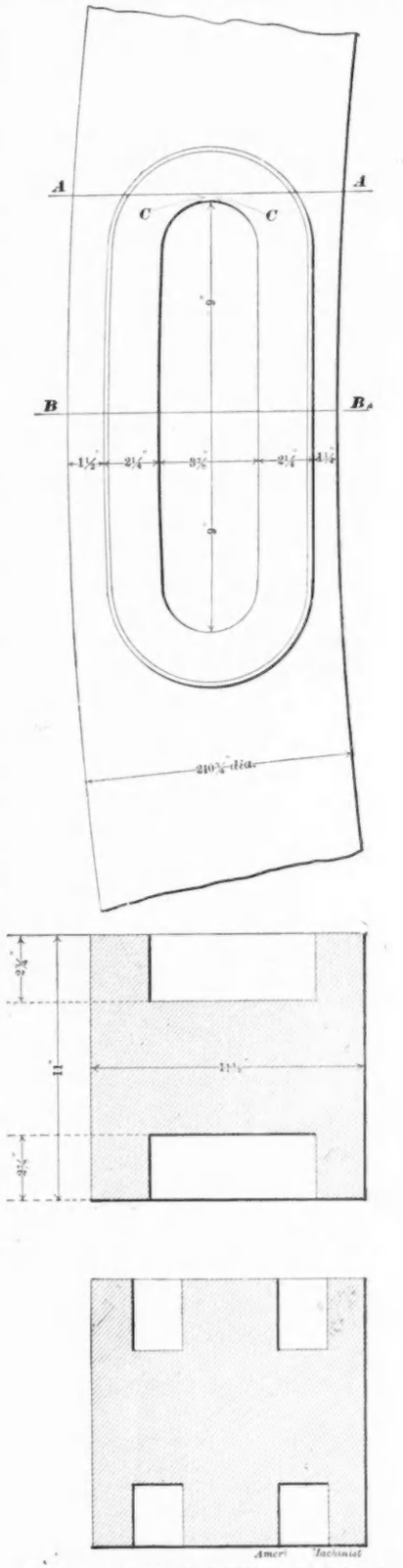
The usual method of estimating the strength of such a joint is to consider the net section to be that shown in section *B B*, Fig. 1, which is the section of the rim through the joint. Mr. Lane points out, however, that this is not the weakest section. The weakest section is in reality that on the line *A A*, or in reality a little less even than this, as it is not to be expected that a wheel would give way on this line, but that the fracture should extend downward on a line like *C C*. The section at this point is materially smaller than the one usually figured on, as will be seen by comparing the two sections. Moreover, this point is where the central lug joins the body of the rim and where the strain is concentrated. This is where the prudent designer would like to get a little extra metal, but it is just where he cannot do it.

Our large engraving, Fig. 2, shows a form of joint which Mr. Lane is applying to a wheel of 30 feet diameter, now under construction. The joint is a simple flanged and bolted affair, as will be fully apparent from the engraving. It is well known that, from the point of view of strength alone, standard screw threads cut out more metal from the bolt than is desirable. In the present case the question of strength is paramount, and consequently the bolts are cut with a thread of fine pitch rather than standard—the threads used being six per inch. This fine thread has the further effect of making the nuts less likely to work loose.

A flange is carried around the periphery of the wheel for the purpose of covering up the joint flanges and avoiding danger from their projection outside the rim.

There are some other interesting points of construction connected with this wheel. There is, of course, no reason why cored holes for the rim-flange bolts do not fulfill all requirements; but in work of this size, cored holes cannot be depended upon to match properly without undue clearance. To meet this, Mr. Lane adopts the very ingenious expedient of making his holes oblong—the longer axes of the holes being at right angles to one another. The holes are also tapered with the small ends toward the bolt head or nut, as the case may be. The construction is shown clearly in the detail of the coring, and its effect is plainly to insure that the bolts shall go through with little or no chipping of the holes, and at the same time give an effective bearing surface to the bolt heads and nuts.

Another feature, which is not shown in the drawing, relates to the foundry work, and is intended to secure uniform length



FLY-WHEEL JOINT WITH SHRUNK-ON RING.

of the segments as cast, regardless of shrinking or swelling of the pattern, or other disturbing influences. The joint

faces of the flanges are not determined by the ends of the pattern, which ends are, in fact, core prints. The core for the bolt holes also makes this end face, and the cores for the two ends are placed in position in the sand by a positive gage, which, being independent of disturbing conditions, insures that the cores shall be placed at a uniform distance apart. This insures uniformity of length in the segments, and reduces the machine work on the joints to a minimum.

▲ ▲ ▲

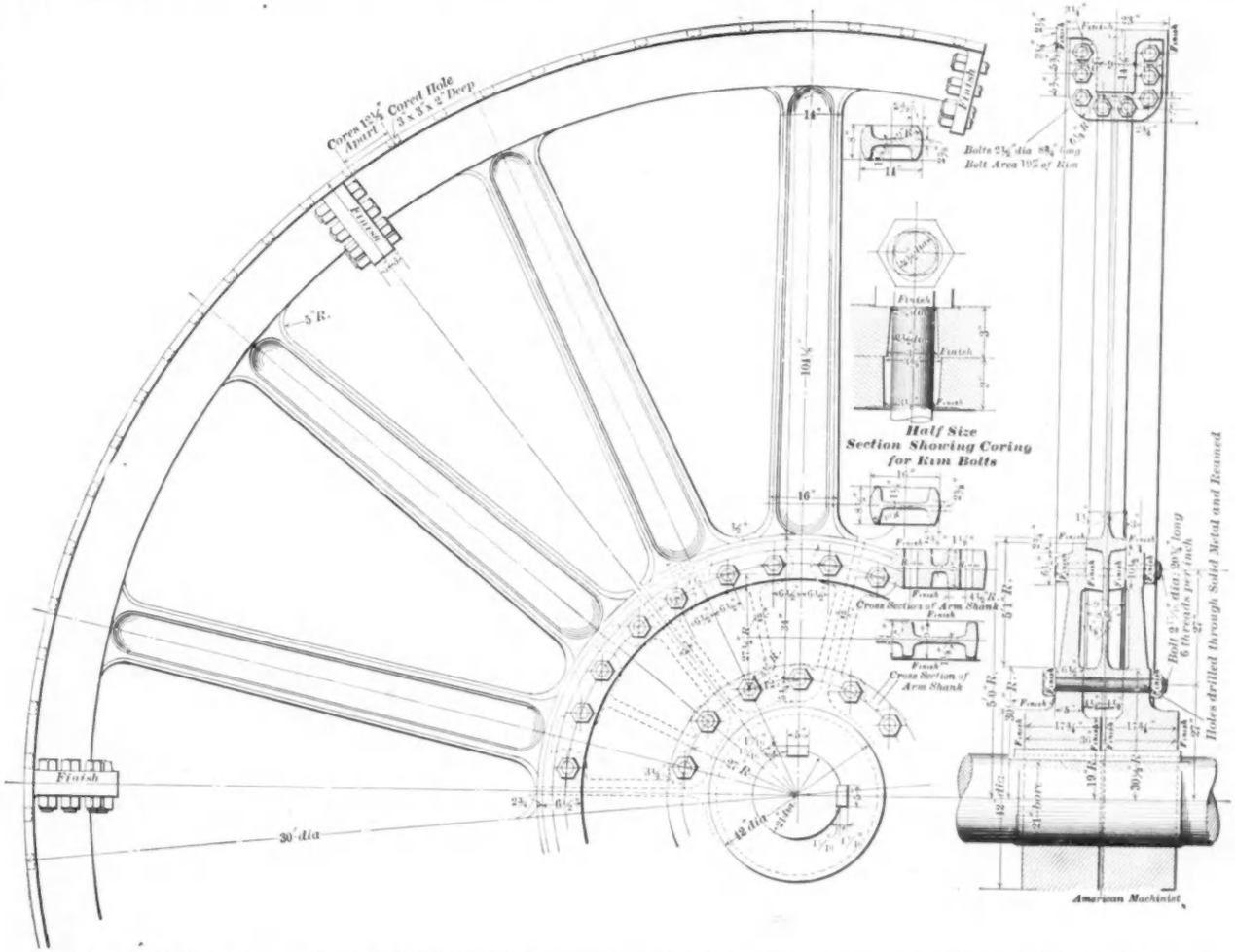
One of the peculiarities of our foreign exchanges is the fact that it is almost al-

Bicycle Tools—XXIV.

HUB DRILLING.

The St. Nicholas Factory, Chicago, has often been mentioned as very original in its equipment. While many of the home-made special tools at the St. Nicholas are by no means to be regarded as models of machine construction, every original St. Nicholas tool design shows a full realization of the demands of the problem, and all of the special tools are worthy of notice as being strictly in the line of economical production.

In the case of any series of operations to be performed on a single piece there are two general methods of procedure—by one method all of the tool spindles are grouped so as to either simultaneously or successively operate on the same piece; by the other method the tool spindles are widely separated, the machine frame being either extended or divided into separate units, so as to carry the tool spindles in what are in effect separate machines, so far independent in their action that one spindle may stand still without interfering with the operation of the others. Thus, in the spoke-hole drilling problem all of the drill spindles may be closely grouped in one machine, or the hub-drilling machine may consist of an assemblage of Stover hub driller shown in Fig. 152. It is obvious that, supposing the multiple-spindle machine has, say, nine spindles, nine single spindles could drill the same number of hubs per day, theoretically. In practice the nine single-spindle drillers would, however, be found to do the most work; because in case of failure of any one of the closely assembled drills, all must stand still while the one is made good. In case of the separated spindles the failure of one of nine does not affect simple single-spindle drillers like the the other eight, which can go on with their drilling while the ninth is restored to working condition. There is also another important consideration in favor of the separated spindle plan; the close spindle machine is, in every sense of the word, special; it can do but the one thing, and must stand still when it has not that particular work to do. In the case of separated tool spindles the framing may be easily such as to accommodate fixtures for various jobs, so that the machines will turn off work as rapidly and cheaply as the strictly special machine, and at the same time have the very great advantage of being able to do anything whatever within their limit of capacity.



30-FOOT FLY-WHEEL FOR 32 x 72 INCH ROLLING-MILL ENGINE. WEIGHT, 85 TONS. BY LANE & BODLEY CO., CINCINNATI, O.

ways a difficult matter to find the address of their publication offices, and in some cases practically impossible to do so. In this country it is the custom to print the address of the publishers prominently on public journals. In other countries it seems to be the custom to print them, if at all, in such an obscure corner as to make them almost undiscoverable. For instance, we have just looked in vain for the address of the "Zeitschrift des Vereines Deutscher Ingenieuse," which is the leading engineering journal of Germany, and English journals are little better in this respect.

But in order to make the separated spindle machines economical, they must not require an attendant for each one; they must be automatic so far as the closely grouped spindle machine is automatic, and, commonly, one step or two steps farther. The multiple-spindle hub driller can economically have a hand-feed for drilling and a hand-indexed hub fixture; the hand is there, and may as well work as be idle; but in the case of the separated spindles the attendant is put in charge of as many machines as he can keep full of work, the hubs, for example, requiring to be put into the drilling fixtures by hand, and to be taken out by hand, but neither the drill feed nor the hub indexing can be hand operations, because the workman must be attending another machine while the drilling is done in the one just made ready for work. Hence, the separated spindle machines must be automatic in drill-feeding and hub-indexing operations.

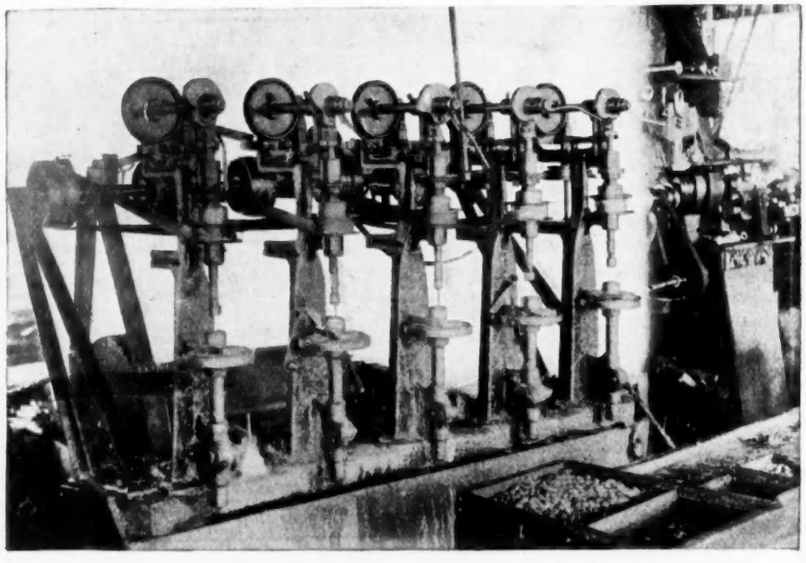


Fig. 153. A BANK OF AUTOMATIC HUB DRILLERS.

In general terms the separated spindle plan is to be preferred when the automatic operations are duplications, so that they can be performed by single-spindle machines without changing the piece from one fixture to another. Where the operations on a piece, say a sewing-machine bed plate, for instance, require milling, boring, drilling and tapping spindles, then the case is different, as it is far better to finish a piece at one setting if it is possible to do so. Every changing of a piece of work from one fixture to another involves the possibility of a misplacement, and it is found economical to make automatic machines with grouped spindles and traveling work-carrying fixtures—in many cases very costly and elaborate productions—rather than to hazard spoiled work by change from one fixture to another.

Influenced by the foregoing considerations, the St. Nicholas made its small drillers with automatic feeds and automatic fixture indexing, and placed similar machines in banks of five, as shown in Fig. 153, with a common horizontal driving shaft in the rear which drives all the vertical drill spindles with two-step cones, and quarter twist belts which are thrown off the cones to stop the drill spindles.

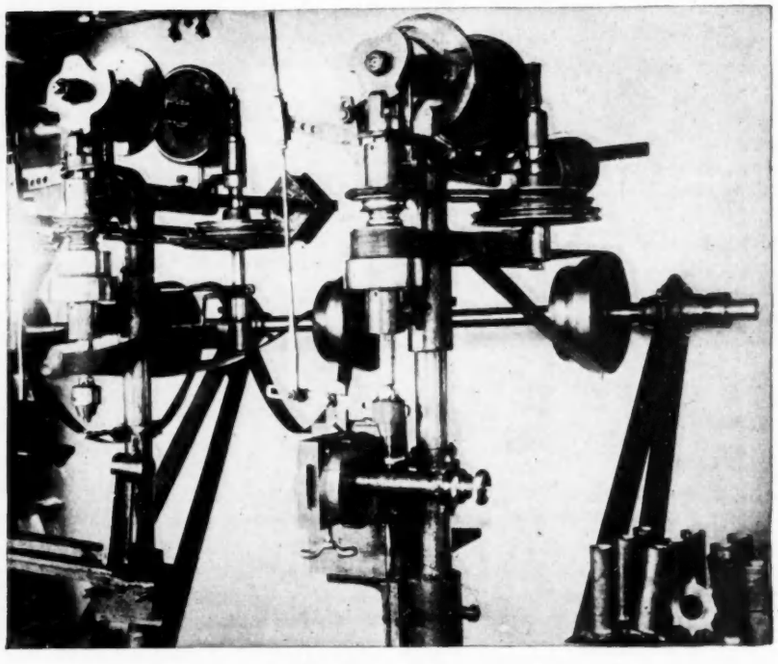


Fig. 154. ST. NICHOLAS SPECIAL DRILLERS.

A round belt leads from a cone on each drill spindle to its vertical worm shaft cone, which drives a worm gear keyed on the cam shaft, the cam shaft being, of course, fitted with cams to give the drill-spindle feed and return, and the work-indexing action. The St. Nicholas shops have several of these five-spindle banks of independent single-spindle automatic drilling machines, which are variously equipped with fixtures for drilling cycle hubs and many other pieces. The engravings are on a large scale and the interested designer can easily pick out the details by inspection. It is not necessary to go into minute detailed description; a wink is as good as a nod to a blind horse; and the tool-maker who is not interested in automatic drillers would certainly skip the details if here given, while the tool-maker who is directly in the line would probably prefer to introduce details of his own devising. It is enough to give such text and such engravings of successful practice as will make the technical reader fully aware of general methods and their advantages, and also give him precedent. Minor details are commonly special to the individual job, and hence not of general value. The St. Nicholas drillers are cheap and effective; they are also banked in accordance with the late practice in all lines of manufacture. The harvester and threshing machine shops bank their drillers in long lines of machines set on one bed plate, so that one man may attend ten or fifteen spindles with automatic feeds, sometimes fitted with auto-returns and knock-off actions also, so that the drill comes up out of the work and stops, leaving nothing for the workman to do except to take the drilled piece out of the fixture, put an undrilled piece in its place and start the drill feed—all of which helps towards selling a reaping machine to the farmer for $75 or $80, which would cost $300 or $400 if made one at a time, by job shop methods and day prices.

The disk-driven Barnes driller also is often used to drill cycle hub spoke holes, and can get around the circle in lively fashion with its high-speed steady-run-

ning spindle, driven with just sufficient friction to drive a drill cut stiff, and yet not with power enough to break it.

The cups and cones which together constitute the ball track are made on the screw machine only, or in some cases are made on the screw machine and refinished in the engine lathe, the cone being quite often so treated to bring the outside true with the inside thread. A good many times it is not very sure that a piece turned up on a threaded arbor is any more nearly true after turning than before, and a piece screwed on a threaded arbor up to a shoulder can never be depended upon to run true with the thread, unless the shoulder of the piece is first made true with the thread. So far as observed, the practice is to run the cone up on a shouldered arbor, both in returning and in grinding after case-hardening—even at the Lozier shops the cones were run up to a shoulder on the threaded nose of the work spindle of the cone-grinding machine. I do not know what had been previously done to square this shoulder with the internal thread of the ball cone, but I much doubt the perfect truth of any work done on a solid-threaded arbor when screwed up hard against the arbor shoulder. I was never able to obtain any true work by that method, and I have tried it a great many times. To bring the outside of an internally-threaded piece true with the thread—absolutely true—I know of no method except that employing a split-threaded sleeve on a taper arbor. The sleeve is split on one side, one cut clear through. The sleeve must be made in the air; that is, on the free end of a piece held in the chuck, so that the thread can be made on the bush or sleeve, and the inside of the sleeve bored and reamed to the arbor taper before the threaded sleeve is cut off the chuck-held bar. The sleeve should be made exactly the right outside thread diameter. After the sleeve is cut off, it has a saw-cut put through one side, and the arbor has a stud in it to fit the saw-cut. With ordinary spindle tapers, the article to be turned can be securely held by a light blow of a wooden mallet on the end of the arbor. Work done on a split sleeve and taper arbor rig of this sort is as nearly true as the tools are, because the work is not canted to one side or the other by a shoulder out of true with the thread.

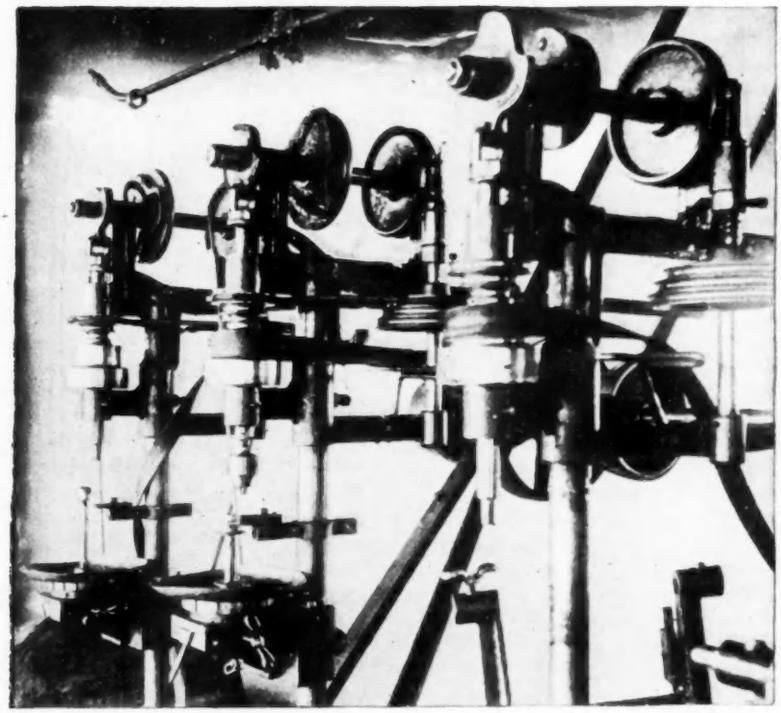


Fig. 155. SOME SPECIAL DRILLS.

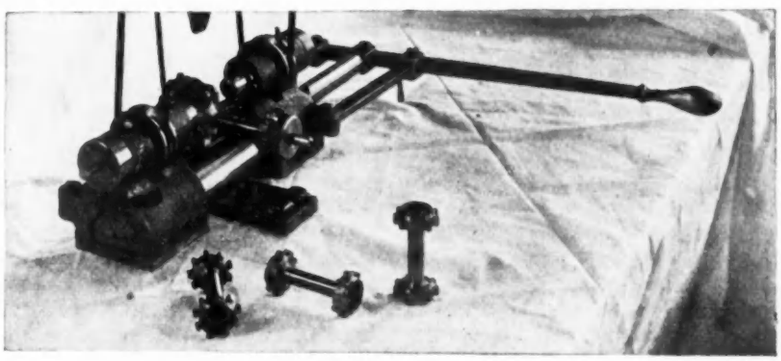


Fig. 156. LIBERTY HUB DRILLERS.

Fig. 156 shows the Liberty hub special two-spindle driller, Rockaway, N. J., shops, and the straight-spoke hub which is drilled on this little trap—one of the two solitary special machine tools in the Liberty shops at the time of my visit to them. The angles of these spoke holes are such as to permit the drilling of two holes at once with the two round belt-driven drill spindles, which are not in line with each other. The one-hand feed lever operates both spindles at once.

HUGH DOLNAR.

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The Mobility of Molecules of Cast Iron.*

There has been a general impression that repeated shocks render cast iron brittle, but experiment establishes the opposite. A thousand tests of bars of cast iron of all grades show that iron is materially strengthened by repeated shocks or blows.

Annealing castings—as, for instance, car wheels—increases their strength by relieving cooling strains; but the molecules of cast iron are also capable of movement without heating, and they can thus rearrange themselves and relieve the overcrowding near the surface of the casting. A molecular annealing may be accomplished at ordinary temperatures, releasing the strains in the castings, precisely as does annealing by slow cooling in hot pits or ovens.

In 1883 the writer noticed that chilled car wheels usually cracked when nearly new, if at all; but nothing resulted from this observation at the time. In 1894 a large number of "transverse test bars," 1 inch square and 15 inches long, had accumulated in the foundry of Wm. Sellers & Co., and to clean them they were thrown into a tumbling barrel and knocked about for several hours. When those test bars were broken in the transverse testing machine, the tabulated record showed that their average strength was considerably higher than was usual with similar iron mixtures. A card pattern was then made, molding twelve test bars at a time, and pouring all by one runner. Six of these bars were tumbled, while the other six were merely cleaned with a wire brush. Upon testing the bars all of those which had been tumbled for about four hours were stronger by

*Abstract of a paper read at the Pittsburgh meeting of the American Institute of Mining Engineers, February, 1896, by A. E. Outerbridge, Jr., of Philadelphia, Pa.

from 10 to 15 per cent. than those which had not been tumbled. Repeated tests gave the same results. Round test bars were tried instead of the square ones, and still the same fact appeared.

These revelations suggested another test, which was carried out. Six bars were given 3,000 taps upon one end of each with a hand hammer. All the bars so treated showed a gain of strength equivalent to that shown by the tumbled bars.

Here was a new revelation, suggesting the possibility of annealing castings at ordinary temperatures by means of this molecular mobility. For years we have been actually doing it unconsciously by tumbling castings in a barrel with a very different purpose in view.

The fact was brought out incidentally that shrinkage strains exist in small castings as well as in large ones. Even in bars of uniform section, such as the 1-inch test bars, the weakening by cooling strains is sometimes as much as 10 per cent. of the ultimate stress. Tests of ½-inch bars showed that they are subject to the same law.

The extent of the influence of this molecular annealing by vibration when cold depends to a certain extent upon the number and force of the blows, and still more upon the grade of iron. Greater relative difference is found in hard mixtures or strong iron than in soft mixtures or weak iron; also, it is greater in 1-inch bars than in ½-inch bars, and somewhat greater in 2-inch than in 1-inch bars.

For impact tests a machine was used consisting of a frame marked in inches, and a wedge-shaped weight, adapted to the size of the pieces to be tested, which was raised any desired number of inches and then allowed to drop free upon the center of the test bar, the supports being 12 inches apart. A 14-pound weight was used for the 1-inch bars.

Such machines have long been used, and car wheels are accepted or condemned upon their evidence. It has been believed that each blow of the drop weakens the casting, and that the final blow merely shows the residual cohesion. In the case of a thoroughly annealed car wheel this may be correct; but as applied to impact testing machines upon an unannealed bar, it is absolutely fallacious. The impact machine itself becomes a means of molecularly annealing and strengthening the test bars.

Six 1-inch square test bars, cleaned with the wire brush, were broken at the first blow by the weight from a sufficient height for that purpose. Six companion bars were then given from 10 to 50 blows each by the same weight falling one-half the distance. The weight was then dropped upon each bar from the height at which the first six were broken, and not one broke. Several blows, and in one case fifteen, from the same height were required to break the bars. In another case the weight was dropped once from the former height, and then raised by successive inches until four more blows, each one inch higher than the last, had been given.

In the test of the molecularly annealed bars from the tumbling barrel, a blow that would break the unannealed bars the first time would require to be repeated from five to twenty times to break the tumbled companion bars. By successive light blows with the drop weight, the bars could be strengthened to equal those that were tumbled.

The experiments here related are a part of the daily records of metallurgical work at the foundry of William Sellers & Company, and the aggregate number is very large, and all the tests corroborate fully the statements here made.

The molecular annealing of cold cast iron by successive slight shocks of course differs from annealing by heat in that it cannot change the condition of carbon in the casting, or alter its chemical constitution in any way.

A few practical deductions may be drawn from the observations made. Hammer frames, housings for rolls, cast-iron mortars or guns, and similar castings, which are to be subjected to severe blows or strains, should never be suddenly tested to anything approaching the full severity of intended service. The molecules of cast iron rearrange themselves under few shocks, so that it is practicable to molecularly anneal such castings cold. Pulleys and most other castings are in everyday service subject to this annealing process, and old castings are therefore more reliable than new ones, unless they have been misused. It is not impossible that the same law applies to steel castings, and that in testing new guns each small preliminary charge enables the gun to relieve itself of internal strains, and eventually to stand shocks which would have at first destroyed it.

The tabulated tests have been selected from the daily records of experiments made at the machine-tool works of William Sellers & Co., Incorporated, Philadelphia.

In Table I, the left-hand columns show the breaking strain and deflection of test bars of different kinds of cast iron, cleaned in the ordinary manner with a wire brush. The right-hand columns show the tests of companion bars, cast from the same runner, molecularly annealed by being subjected to shocks in the tumbling barrel, or by tapping on one end with a light hammer, as noted under "Remarks;" also, a few tests made with round bars 1⅛ inches in diameter, cast on end.

Table II gives a few of the tests with 1-inch bars, made upon the new impact testing machine, using a 14-pound weight. The tests marked A represent bars cleaned with a brush, and those marked B, companion bars, molecularly annealed in the manner described:

TABLE I—TRANSVERSE STRENGTH.

Unannealed.		Molecularly Annealed.		Remarks.
Breaking Strain. Pounds.	Deflection. Inches.	Breaking Strain. Pounds.	Deflection. Inches.	
2350	.13	2850	.14	Close grain.
2025	.12	2300	.14	Open "
2125	.13	2275	.14	" "
2275	.13	2400	14	" "
2525	.14	2850	.15	Close "
2175	.13	2500	.15	Open "
2100	.13	2375	.14	" "
2025	.12	2300	.14	" "
2775	.14	2900	.15	Close "
2150	.13	2250	.13	Ham'red on end of bar.
2550	.14	2925	.15	" " " "
3000	...	3200	...	Round bars 1⅛ in. dia.
3000	...	3150	..	Ham'red on end of bar.
2150	...	2450	...	Round bars 1⅛ in. dia.
2100	.13	2425	.15	Open grain.
2100	..	2400	...	Round bars 1⅛ in. dia.
2050	.12	2400	.14	Open grain.
2875	.14	3100	.15	Close "
2175	.13	2500	.15	Open "
2150	.13	2350	13	" "
2675	.13	3000	.14	Close "
2775	.14	3300	.15	" "

TABLE II—IMPACT.

A. 1 blow of 14-pound weight falling 13 inches broke the bar. Open grain.
B. 8 blows of 14-pound weight falling 13 inches broke the bar. Open grain.
A. 2 blows of 14-pound weight falling 14 inches broke the bar. Open grain.
B. 9 blows of 14-pound weight falling 14 inches broke the bar. Open grain.
A. 2 blows of 14-pound weight falling 14 inches broke the bar. Open grain.
B. 14 blows of 14-pound weight falling 14 inches broke the bar. Open grain.
A. 2 blows of 14-pound weight falling 15 inches broke the bar. Open grain.
B. 15 blows of 15-pound weight falling 15 inches broke the bar. Open grain.
A. 3 blows of 14-pound weight falling 15 inches broke the bar. Open grain.
B. 8 blows of 14-pound weight falling 15 inches broke the bar. Open grain.
A. 2 blows of 14-pound weight falling 15 inches broke the bar. Open grain.
B. 7 blows of 14-pound weight falling 15 inches broke the bar. Open grain
A. 3 blows of 14-pound weight falling 13 inches broke the bar. Close grain.
B. 4 blows of 14-pound weight falling 15 inches broke the bar. Close grain.
A 2 blows of 14-pound weight falling 13 inches broke the bar. Close grain.
B. 10 blows at 13 inches, 5 at 15 inches, 5 at 17 inches, 3 at 18 inches, broke the bar. Close grain.
A. 1 blow of 14-pound weight falling 14 inches broke the bar Open grain.
B. 20 blows at 13 inches and 3 blows at 14 inches broke the bar. Open grain.
A. 3 blows of 14-pound weight falling 13 inches broke the bar. Close grain.
B. 15 blows of 14-pound weight falling 14 inches broke the bar. Close grain
A. 8 blows of 14-pound weight falling 12 inches broke the bar. Close grain.
B. 50 blows at 12 inches and 10 blows at 15 failed to break the bar.

NOTE.—The last bar, after withstanding these blows, was broken upon the transverse testing machine at a strain of 2,975 pounds.

Throughout the paper the hypothesis of the mobility of the molecules of cast iron has been adopted; it is, of course, possible that the theory may not be correct, but the tentative propounding of a probable hypothesis often leads to the establishing or the disproving of the theory, and thus adds to our stock of positive knowledge.

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M. Maudon, of Paris, engineer with Fenwick Bros., has returned home after placing several good orders here for tools. He states that the Pratt & Whitney Co. are to make metric taps and dies for French trade, and that it is expected that there will be an increasing demand for them.

Laundry Machinery and the Latest Laundry Machines.

Probably next to the steam engine itself the machinist is more interested in pumps than in any other single line of machinery, and rightly so, for probably no line of machinery has employed so much ingenuity in its development and has developed into a greater variety of forms than the pump for water. And yet the raising of water when reduced to its lowest terms, is one of the simplest of operations; far more simple, for instance, than the operation, for which the pump furnishes the most essential requisite, of cleansing linen and putting it into attractive condition for the use of civilized humanity. Few of the refinements of modern life are more all-pervading than the modern laundry, which dominates especially the bath, the table, the bed-chamber, and is supreme in the personal adornment of the individual. There is then, upon the face of it, a strong presumption that in the complete line of modern laundry machinery much may be found of interest to the mechanic, and an acquaintance with the subject fully sustains the presumption.

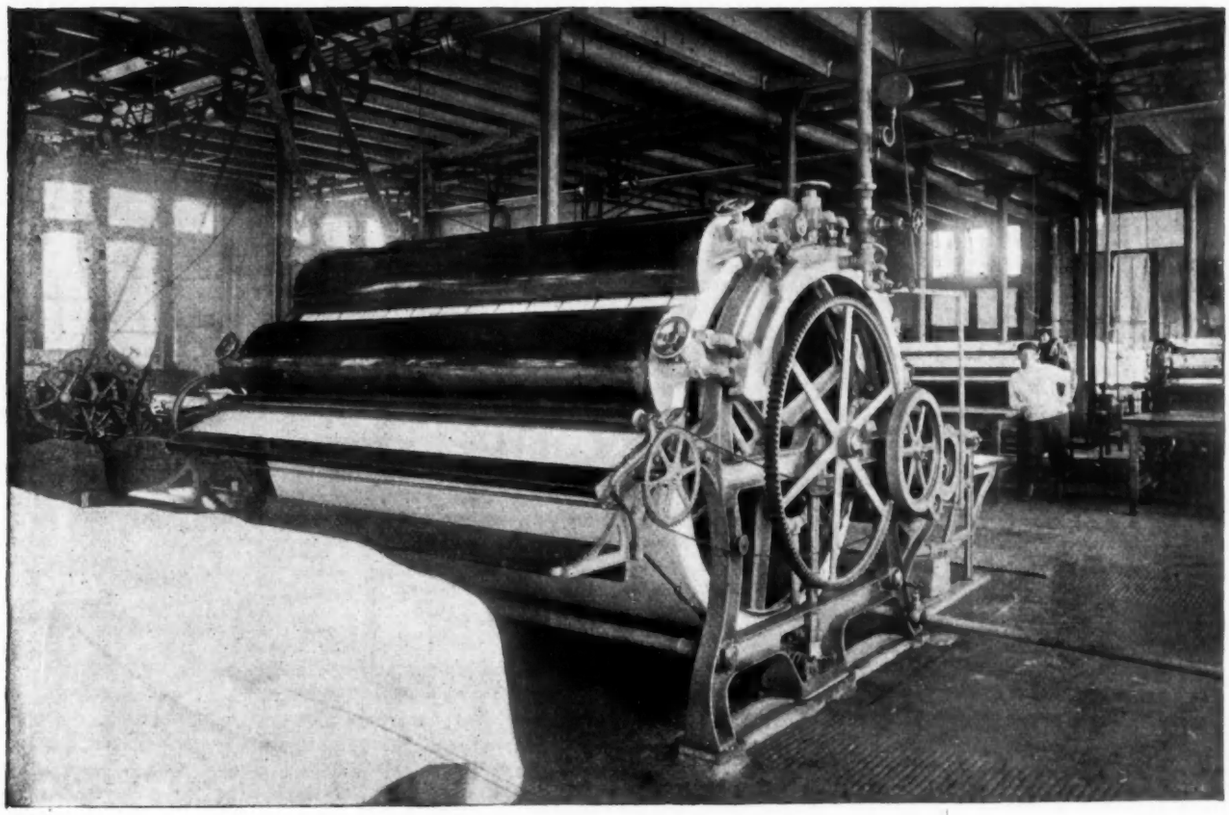
A catalog or list of the machinery employed in a modern laundry shows a great variety of apparatus, and gives evidence of a wide range of inventive and constructive talent employed in its production. From personal knowledge of the development of laundry machinery, we know that some of the apparently simplest machines have cost a vast amount of experimenting, and are the survivals of many failures and discouragements. Some of the machines are sufficiently complicated and elaborate to challenge the admiration of the most advanced mechanic.

A collar goes to the laundry around the corner and comes back to us in spotless purity, in perfect whiteness or with the faintest tinge of blue, with the finish of the surface, the shape and the stiffness all perfection—a result in its completeness absolutely unattainable by the time-honored hand laundress—and it costs at the most two cents. Saying nothing of the filtering of the water and the chemical analysis of it, rejecting as especially fatal all traces of iron, of the chemical investigation of soap and bleach and starch and bluing, and of the mechanical operations, each with its special apparatus, of washing, rinsing, bluing, starching, drying, in centrifugal machines and then in the dry room, and the dampening of the collar again before ironing, the simple operation of ironing the flat collar is worth calling attention to.

The operation is simple enough. The collar is passed between a hot, polished iron roll and a cloth-covered roll, and it comes out all right. For this simple operation there are a wide variety of machines with a great range of capacity and efficiency. There is one machine, now at least twenty years old, in use in the collar factories of Troy and in the great laundries of the large cities, whose price is up in the thousands and which will iron 14,000 collars per day.

There are two hot rolls in the machine, and also two "clothed" rolls. The hot rolls must be of the closest-grained iron and absolutely without a flaw or a suggestion of sponginess. In the building of these machines we have known the rolls rejected for astonishingly minute defects of surface. The rolls must be highly polished, and before use they must be waxed, the trick of which operation it is not given to every one to acquire. The roll is heated by a special gas burner, which has itself been the subject of much study and experiment. There are a series of jets about 1 inch apart, and the several flames are an inch or so in height. The air is supplied to the burner by a blower and is mixed with the gas in the central tube before emerging, and the air is also supplied to the jet externally after it emerges. Three valves require manipulation to adjust the jets to perfect combustion and to secure the right heat for the roll.

The "clothed" roll or drum, between which and the hot roll the collar passes, is a very different thing from the hot roll. It consists, first, of an iron open-ended cylinder, about 15 inches in diameter and ½ inch thick, mounted by two spiders upon a heavy shaft. This cylinder is turned true and left rather rough, with all the



THE LATEST LAUNDRY MACHINE.

tool-marks upon it. It then goes to a rubber factory and is covered with elastic rubber of a certain standard of hardness and, say, 3/8 inch thick. Upon this is stretched a covering of very thick, specially manufactured woolen felt. The size required for the felt jacket is ascertained by measuring, and it is cut and the ends are butted and carefully sewed together. The felt is then soaked in boiling water and stretched by a special apparatus until it will just draw tightly over the drum. After it is drawn on, the ends of the felt are turned in over the open ends of the drum, and iron followers are drawn in by a series of long screws, thus securing the ends of the felt. The jacket is then allowed to dry. The followers are provided with wooden faces on the outside, and when the felt on the drum is dry it is placed in the machine and a large quantity of cotton cloth is then carefully wound upon it, the ends of this cloth being turned over the ends and tacked to the wooden faces of the followers. Every detail of the operation of preparing the drum is conducted with great care, and reliable expertness in the operation is valued.

These drums revolve quite slowly; the collars are fed in horizontally, with the outside of the collar upward. The clothed drum is above and the hot roll is below, so that the back of the collar is finished first. After passing these rolls, means must be provided for preventing the collar from sticking to the hot roll, or from curling up, thus making it sure that the apron will receive it flat and properly deliver it to the finishing rolls. Here the hot roll is above and the clothed drum is below. The pressure and the relative speed of rolls must be carefully adjusted. The surface of the hot roll must move faster than that of the drum, the last hot roll must move faster than the first one, and the speed of this last one must be greater or less as the vagaries of fashion or of individual taste may demand more or less gloss of finish. If a high polish is required, a third hot roll is provided. Various change gears are furnished to meet the different requirements, and cut gears are used throughout the machine, their number being over forty. All this detail may not interest every machinist, but we trust that it will be of some interest to many, and that it will contribute to a better appreciation of one class of machinery that some may have been disposed to regard rather lightly.

The prejudice which has prevailed in some quarters against laundry machinery and the modern laundry system, as being destructive of the goods, is entirely incorrect and unwarranted. That bleaching compounds, the wash wheel, the wringer or the ironing machine may be converted into agents of destruction is, of course, true; but their normal function is to save rather than to destroy. The wringer might possibly do mischief, and so it is practically banished, the centrifugal machine doing its work quicker and more thoroughly. The best hotels, and other institutions equipped with laundries, now generally enforce the rule that no piece of linen, towel, napkin, table-cloth, sheet or pillow-case shall ever be used a second time. If all the laundry work implied by this practice were to be hand work, the rate of destruction would be incomparably greater than with the mechanical appliances.

The machine which we show herewith is entirely different from the collar-ironing machine of which we were speaking above. The view of it which we present, by the way, was taken in the laundry of the Pullman Car Company at Chicago, and shows the machine as established and in actual use there. It is the latest evolution of the steam mangle, and is used for "mangling" or ironing the linen used in the palace cars, sleeping cars or dining cars upon our railroads.

The machine shown is said to weigh ten tons and costs $3,000. The figures are not official, and are only mentioned to show that the machine is worthy of respect. From personal observation we would say that the weight may have been slightly exaggerated. The central drum is 6 feet in diameter and 9 feet long. Its periphery is of perforated metal and is covered with many layers of cloth. It is mounted in vertically sliding boxes and is raised or lowered by screws at each end, which are made to act together. Upon the same frame are mounted five steam-heated and polished cast-iron rollers. These rollers have a limited movement radially, and the pressure upon each is adjustable at each end by means of a spring and a screw with a hand wheel upon it. The steam, under considerable pressure, is admitted to the roll and also conveyed away from it through the same end. The discharge pipe has a bent pipe inside the roll, which dips to the bottom of the roll and conveys away the water of condensation. These steam rolls are each covered with a hood of polished copper, asbestos-lined, to prevent radiation. The goods are conveyed to the rolls by means of a traveling apron, and are also delivered upon an apron. The fingers of the feeders do not come near the steam rolls, so that there is no danger of being caught. The hands can only come in contact with a light wooden roll which turns by its own weight in contact with the apron, and the roll is always free to move and release anything that may be caught. The machine will iron 450 to 500 heavy Austrian linen sheets in an hour, 1,800 pillow slips in the same time, and an equivalent quantity of table-cloths, towels, napkins or any other flat work. The hot rolls, of course, come in contact with but one side of the goods in this machine. Another machine, although not as large as this, irons the goods upon both sides, and gives them a better finish where it is wanted.

The mangle is built by the Troy Laundry Machinery Company, which has factories at Troy, N. Y., and at Chicago, with offices at Troy, Chicago, New York and San Francisco.

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Costly Speed.

The French torpedo boat Forban upon her official trial made an average speed of 31.029 knots. London "Engineering" says: "Three runs were made on the measured mile . . . and the coal burned in this time amounted to 5,940 pounds. . . . It may be added that during a run of eight hours' duration, at 14 knots speed, the consumption of fuel was 423 pounds."

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Mr. Edgar C. Seebohm, the representative sent to South Africa by the J. A. Fay & Egan Co., of Cincinnati, O., had an experience recently at Johannesburg, where he was sent to install some machinery for his company. As a consequence, he writes to suggest that a change be made in the pattern of the column of his company's band mill, as he had difficulty in getting it through the Custom House, the Boers taking it for a large cannon or some sort of a machine gun and wanting to confiscate it. Mr. Seebohm says that it took any amount of talking to convince them that it was a part of a band mill, and that they are even now a little skeptical as to its being what he claims, and ride past every hour or so to watch the progress made in its erection. He is afraid they may yet make up their mind it is some kind of a weapon and take it—and him with it. They wanted to run him in for blowing his bicycle whistle, and did in fact run in the whistle. He experiences great difficulty in procuring the necessary labor to erect the mill, as the Kaffirs have all left for their homes in expectancy of war, the indication being that the whole of South Africa will form a combination against the English.

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Bids were opened by the Secretary of the Navy on May 2d, for furnishing the United States battleships "Kearsarge" and "Kentucky" with about 6,000 tons of nickel-steel armor, with the necessary bolts and nuts, and also certain hollow forgings, such as communication tubes, conning towers, etc. The specifications provide that a part of the armor be treated by the process of supercarbonization known as the "Harvey process." The bidders were as follows: Bethlehem Iron Co., South Bethlehem, Penn.; for the "Kearsarge" $1,573,390, and for the "Kentucky" $1,569,750. Carnegie Steel Co., Pittsburgh, Penn.; for the "Kearsarge" $1,568,162.50, and for the "Kentucky" $1,572,477.50. This gives the work for the "Kearsarge" to the Carnegie Co., and for the "Kentucky" to the Bethlehem Co.

ELECTRICAL MACHINERY.

Electromotive Force, Counter Electromotive Force and Speed.

The E. M. F. of a generator depends upon the number of wires on the armature, the strength of the field magnets and the speed. In any given machine the number of wires on the armature is, of course, fixed, and the E. M. F. can only be varied by varying the speed or the strength of the field magnets. Suppose a generator having separately excited and constant fields to be in motion with the outside circuit broken: An E. M. F. will be generated at the terminals depending upon the speed and the strength of the field magnets. No current will flow because of the circuit being open. The power consumed in generating a current is equal to the product of the number of volts of E. M. F. by the number of amperes of current; and since the amperes are here zero, the power consumed will be zero—that is, no power will be consumed by the generator other than that necessary to turn it in its bearings. Now let the circuit be completed with a large resistance: A small current will flow and a small amount of power will be consumed equal to the product of the number of volts by the number of amperes. Let the total resistance including that of the armature, be halved, and the amperes will be doubled and with them the power will be doubled, since the E. M. F. will remain unchanged or practically unchanged—we say practically unchanged, since in point of fact the E. M. F. will drop slightly at the terminals as the outside resistance is decreased. With the outside circuit broken, no current flows and the full E. M. F. due to the speed will appear at the terminals. When the outside circuit is completed, current flows, a part of the full E. M. F. will be used up in forcing this current through the armature wires, and a less E. M. F. will appear at the terminals. As the outside resistance is decreased and the current increased, the amount of the E. M. F. used up in the armature will increase with the current, and the amount of remaining E. M. F. will decrease. Since, however, under normal conditions, the resistance of the armature is always small in comparison with the outside resistance, the proportion of the E. M. F. used up in the armature will be small, and the E. M. F. appearing at the terminals will be nearly constant, regardless of the variation in the outside resistance within usual limits.

In all that has been said, it should be remembered that the fields are supposed to be supplied from an outside source, and so be of constant strength. In point of fact, when, as usual, dynamos magnetize their own fields, the winding can be so arranged that the fields will strengthen as the current increases, and so maintain or even increase the E. M. F. with an increase of current. The E. M. F. which appears with an open circuit is called the total E. M. F., and that which appears when the circuit is closed is called the effective E. M. F. When the E. M. F. of a generator is spoken of without qualification, it is the effective E. M. F. which is meant.

If the generator which has been considered have its speed changed, the E. M. F. will be changed in proportion; and as the amperes of current under a given resistance are proportional to the E. M. F., it follows that the current generated will likewise vary in proportion to the speed. It should be noted, however, that since the power is the product of the volts and amperes, the power will vary faster than the speed. If the volts and amperes are both doubled, the power will be quadrupled, and so for any change—in other words, the power varies as the square of the speed. This will show at once the great advantage of high speed in dynamos.

The generation of an E. M. F. is due to the motion of a conductor in the vicinity of a magnet in such a direction as to cut the lines of force. It matters not by what power this motion is produced. In a generator the power is mechanical power applied from without. In a motor the conditions are the same, except that the power is derived from the action of the magnets on a current supplied from without. This does not affect the generation of an E. M. F., which, precisely as in a generator, is produced by the motion of the armature coils in the magnetic field. It is a universal law of all electric action that the effect produced always opposes the force which produces it. In consequence of this law the E. M. F. produced in a motor acts to oppose the E. M. F. which drives the motor. Hence the E. M. F. of a motor is called the counter E. M. F. Its magnitude follows the same law as the E. M. F. of a generator that is, it is proportional to the strength of the field magnets and to the speed. It follows at once that the higher the speed at which a given motor armature is allowed to run, the higher the counter E. M. F. will be, and, if the applied E. M. F. be constant, the smaller the current flowing through it. Could the speed be high enough, the counter E. M. F. would equal the applied E. M. F., and no current would flow. Under these circumstances the motor could develop no power, and hence such a speed is impossible in a motor. We see thus that the counter E. M. F. must be less than the applied E. M. F. Should, however, an engine be belted to the motor to assist it, and should the speed of the engine and motor be increased, the counter E. M. F. would rise until at a certain speed it would equal the applied E. M. F. At this point no current would flow through the motor armature, which would do no work, but its former work would be carried by the engine, and itself would simply turn idly in its bearings. Should the speed be increased still further, the E. M. F. of the motor would increase still further, when it would exceed the applied E. M. F., and the motor would become a generator driven by the engine.

The counter E. M. F. of a motor acting to oppose the current, it would be natural at first sight to look upon it as being of the same nature as the resistance of a wire. In point of fact, however, its effect is quite different. While the resistance of a wire opposes the current, it does not stop it. No matter what the resistance, current will flow through it—a large current if the resistance be small, and a small current if the resistance be large. The effect of counter E. M. F., however, is to act to the extent of its amount as an absolute dam to the current. Thus, suppose the resistance of the armature to be 10 ohms, and the applied E. M. F., 100 volts: If the motor be held stationary so that there be no counter E. M. F., the current will be $\frac{100}{10} = 10$ amperes. Now let the motor be released and allowed to turn at such a speed that a counter E. M. F. of 90 volts is developed: These 90 volts simply neutralize 90 of the applied volts, and leave remaining 10 effective volts to force current through the 10 ohms. Under these circumstances the current will be $\frac{10}{10} = 1$ ampere. A further consideration will show that while the current is exactly inversely proportional to the resistance, it is not inversely proportional to the counter E. M. F. Thus, suppose the applied E. M. F. to be 100 volts, the counter E. M. F. 99 volts, and the resistance of the wire 10 ohms: The effective E. M. F. is now $100 - 99 = 1$ volt, and the current $\frac{1}{10}$ ampere. Now let the speed be reduced so as to reduce the counter E. M. F. to 98 volts: The effective E. M. F. becomes $100 - 98 = 2$ volts, and the current $\frac{2}{10}$ amperes. In other words, reducing the counter E. M. F. a little more than one per cent has doubled the current. This principle is at the base of the operation of shunt-wound or constant speed motors, and is very important.

It should be noted here that the work done by the current is not that due to the effective voltage and the amperes. Take the case above of an applied E. M. F. of 100 volts, counter E. M. F. 98 volts, wire resistance 10 ohms, and consequently a current of $\frac{2}{10}$ ampere: It might at first sight be imagined that the power expended by the current would be $2 \times \frac{2}{10} = \frac{4}{10}$ volt ampere or $\frac{4}{10}$ watt, but this would be an error. The power expended by the current is that due to the full applied voltage multiplied by the amperes, namely, $100 \times \frac{2}{10} = \frac{200}{10} = 20$ watts. The $\frac{4}{10}$ watt is the power expended in overcoming the wire resistance; that is, it is the lost power,

since its only effect is to heat the wire. The number of volts of counter E. M. F., multiplied by the amperes, namely, $98 \times \frac{2}{10} = \frac{196}{10} = 19\frac{6}{10}$, is the power realized by the armature, as has been said before, and we observe that $19\frac{6}{10} + \frac{4}{10} = 20$, as it should.

Next imagine a motor (still with its field magnets kept at constant strength by a current from without) to be at work under the constant applied E. M. F., and loaded with a friction brake: The speed is such that the counter E. M. F. allows a current to flow whose power equals that absorbed by the brake. Let the pressure of the brake shoe on the brake drum be decreased: The amperes of current multiplied by the volts of counter E. M. F. is now in excess of the work to be done, and the speed increases. This increased speed develops more counter E. M. F., which checks the current, this process going on until the new counter E. M. F. multiplied by the new current equals the reduced power absorbed by the brake. We thus see that a decrease of load is accompanied by an increase of speed and a decrease of current. On the other hand, if the brake-shoe pressure be increased the speed will slow down, which, developing a smaller counter E. M. F., will allow more current to flow, until the product of the new counter E. M. F. by the new current equals the new load. As has been shown, the increase of current is much greater than the decrease of counter E. M. F.; and since the change in counter E. M. F. and speed go together, the change in speed will be or can be made comparatively small. This is effected by providing that in the first place the field strength shall be constant, and in the second place the wire resistance of the armature shall be small. The small resistance of the armature insures that the counter E. M. F. shall nearly equal the applied E. M. F. As has been shown, under these conditions the variation of current for different loads will then be obtained with a small variation in speed.

If the load on the brake be indefinitely increased, the current will continue to increase; and if the load be made too great, the resulting current will be more than the motor can carry, with a burned-out armature as a result.

It will be seen that so far as the armature alone is concerned, the counter E. M. F. depends on the speed alone; and the E. M. F. is often said to be a matter of speed only. This statement should, however, be qualified by prefixing "with a constant field."

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The cordiality (?) with which the electrical press has welcomed the new illuminant acetylene, is closely parallel with the reception of the electric light by the gas journals of fifteen years ago.

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"The Electrician" (London) states that there is not a single direct coupled tramway or railway electric generator in the United Kingdom.

The Electric Motor for Intermittent Work.

The growing applications of the electric motor are constantly giving rise to new problems, and one of these which has recently come to the fore is the driving of machines in which the resistance to the driving power is irregular in character and fluctuates through wide limits. For the driving of most ordinary machinery, motors which shall maintain a constant speed under variations of load are required, and for this purpose the shunt-wound motor is ordinarily supplied. In such motors a single conductor enters at one binding post, and a similar conductor leaves at the other. Between the binding post, however, two wires are laid—one, of fine wire and high resistance, passes around the field magnets and magnetizes them; the other, of comparatively coarse wire and low resistance, passes around the armature. The current, entering at one binding post, divides between the two conductors. The resistance of the field coils is constant, and since the current is supplied to the binding posts at a constant voltage, or as nearly so as possible, the current through the field coils is always the same, regardless of the load. With the armature, however, the case is different, as the resistance of the armature wires forms but a part (and a small part) of the opposition to the current in that circuit. There is a constant reaction going on between the load and the current, somewhat similar to that going on in a steam engine. As the load on an engine increases, the governor gives more steam to meet it, and in a somewhat similar way, as the load on a motor increases, the current through the armature increases to meet it. With an engine, however, there is a limit to this action. When the governor has given a cylinderful of steam it can go no further, and if this is not enough for the load the engine slows down or stops. The engine, so to speak, knows when it has got enough. With a motor there is no measuring-out of the current by the cylinderful, and as the load increases, the current increases indefinitely—the motor making a desperate effort to meet the load, even to the point of its own destruction. It will be seen, then, that a motor armature must be made able to carry the current due to the heaviest load that comes upon it, and if the load be very irregular, the motor may require to be far larger than its average horse-power would indicate.

A case of variable resistance is found in metal planers, in which the resistance offered by the machine at the moment of reversal of the table is far higher than at other times, and may be so high as to lead to serious consequences unless the motor is able in some way to meet it. This great effort at reversal is due to the work done in accelerating the motion of the table and its load, together with the pulleys. This has to be done at each end of the stroke of the table; but since the return stroke is at the higher speed, more work and more effort on the part of the motor are required in getting up to speed for the return stroke than for the cutting stroke.

Such an application has recently been made by the Crocker-Wheeler Electric Co., to a new planer at the works of Bement, Miles & Co., of Philadelphia. The planer is ten feet square, and is of the newest and heaviest construction. It is the purpose of this article to explain the steps by which a motor which at first was entirely inadequate to the work of reversal, was made to do the work with entire success—the expedients adopted having the effect of reducing the current at the peak to a point which the motor could carry without difficulty.

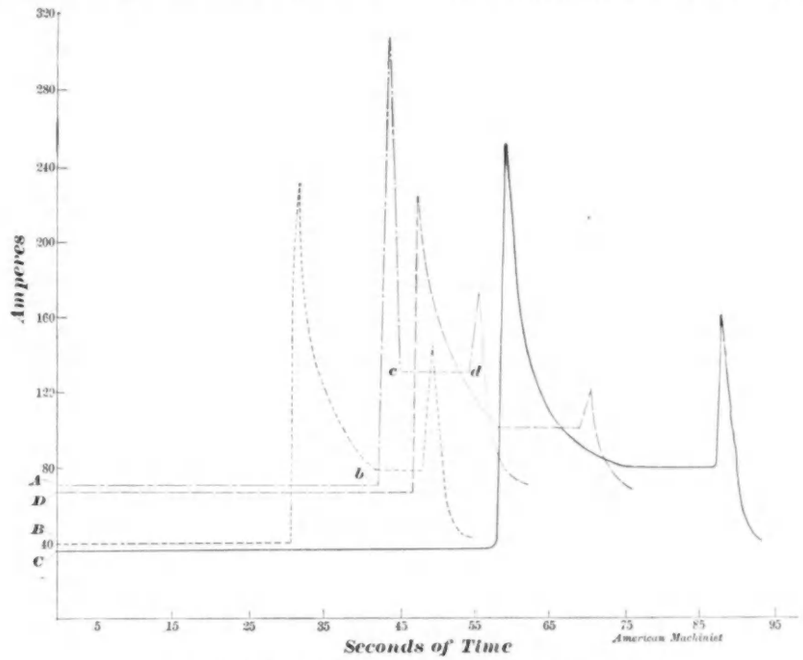
The motor, as at first supplied, was an ordinary shunt-wound machine, as has been described, and of 25 horse-power. During the cutting and return strokes (after speed of the table had been established) the current was well within the limits of what the machine could carry; but at the movement of reversal the current ran beyond what the armature could carry, even as a momentary load only, and at the same time this tremendous current through the armature so disturbed the position of the neutral line as to give rise to violent and destructive sparking at the commutator.

In the accompanying diagram line *A* represents the current required for a complete stroke, with the motor wound as described, and with the planer loaded with a casting weighing 19½ tons, but not cutting. The divisions of the horizontal base line represent seconds of elapsed time, and the divisions of the vertical line at the left represent amperes of current consumed by the motor. Beginning at the left of line *A*, the current during the cutting stroke will be seen to be about 71 amperes, which continues steadily until the completion of the stroke and reversal of the table at *b*, when the current jumps at a bound to 308 amperes. As the motion of the table is established, the current drops to 130 amperes at *c*, which represents the power required for the return stroke. The line for the return stroke is shorter, and its height above the base line greater, than that for the forward stroke, because of the higher speed. At *d* appears another jump for the reversal to start the next cutting stroke, which jump is smaller than the first one, because less power is required to accelerate the table for the slower cutting stroke. From this second peak the current drops rapidly to the same point as for the previous cutting stroke. This great current at the moment of reversal of the table is, of course, due to the effort of the motor to supply the torque or twisting effort to accelerate the table, and the first attempt at reducing it was through the insertion of a fly-wheel in the

motion. This was put on the countershaft in the shape of a heavy rim belt pulley, to which the motor was belted. Its effect is shown in line *B*. The current at the peak of line *B* is 232 amperes, which indicates a considerable effect on the part of the fly-wheel. This appearance is, however, partly deceptive, since when the readings for line *B* were taken the load on the planer table weighed 5½ tons only. The amperes consumed on the cutting stroke will be seen to be but 40 against 71 for the previous heavy load, although the planer was cutting in the second case, and not in the first. Line *C* represents the consumption of current with the same load on the table, but not cutting, and, incidentally, a comparison of lines *B* and *C* shows how small is the efficiency of these large planers. Scaling the diagram shows that the amperes consumed when cutting were 40, and when not cutting 36, giving an efficiency of but 10 per cent. This efficiency is, however, based on the cutting stroke only. The power consumed during the return stroke, and in establishing the motion of the table, is of course all waste, and an efficiency calculated on the entire consumption of power would be still less. It must be remembered that this diagram is from a very large planer. Of course, the weight of such tools and the weight of the work handled by them increase much faster than the size of the cut. A much smaller planer might take as heavy a cut as this one, and so consume as much power in the cut; but it would not have so heavy moving parts, nor could it handle such heavy pieces. It is apparent from this consideration that the efficiency of tools must in the nature of things diminish with increase of size and capacity, and the figure given here is not to be taken as applicable to planers of more moderate dimensions.

It will be seen that the peak of the current for the reversal is higher for the line belonging to the stroke in which no cutting was done. This is due to some unexplained or accidental cause.

At first thought it would appear that the application of the fly-wheel should accomplish the purpose aimed at. Reflection will show, however, that the addition of a fly-wheel does not change the action of the motor except in degree. With the fly-wheel in motion, the acceleration of the table is done at the expense of the fly-wheel's motion, and the motor must then bring the fly-wheel up to its normal speed instead of, as before, bringing the table up to speed. The fly-wheel can be made to spread this action over a longer time, and so lessen its intensity, but the nature of the action is not changed. There are, obviously, some nice points involved in determining the weight and velocity of a fly-wheel most suitable for a given case. In point of fact, in some applications it has seemed to do more harm than good, although in this case its action was beneficial. This effect was, however, insufficient to bring the current down to a safe point when doing heavy work, and a further and successful attempt to reduce it was made by a change in the winding of the motor.



THE ELECTRIC MOTOR FOR INTERMITTENT WORK.

A—Running planer with 19-ton casting on bed, not cutting, ¼ stroke.

B—Running planer with 5½-ton casting on bed, light cut with tool, about ½ stroke; 1,000-pound fly-wheel on countershaft.

C—Same as *B*, not cutting, full stroke.

D—Running planer with 26-ton casting on bed, not cutting, a little over ¾ stroke; fly-wheel on countershaft and specially designed winding for fields.

It has been stated that the motor was originally a shunt-wound machine, in which the current through the field coils is constant under all conditions of load. It consequently followed that the only way of getting the increase of torque necessary for reversal of the table was by the increase of current in the armature, and to get the necessary increase of torque a very large increase of current was necessary. It will be obvious that if this same increase of current could be made to increase the strength of the field magnets, it would act to increase the torque in two ways—first, by the increase in the armature coils, as before; and secondly, by the increased strength of the field magnets. These two effects would add themselves together, and a given increase of torque would be obtained by a correspondingly smaller increase of current. At the same time the increased field strength would tend to hold the neutral line steady, and so prevent the tendency to spark at the commutator. This effect is produced by the addition of a special coil to the field magnets.

The effect upon the consumption of current is shown in line *D*, in which the current at the peak is 226 amperes. This does not appear to be a very large improvement over line *B*; but it will be observed that while with line *B* the load carried was but 5½ tons, that carried with line *D* was 26 tons—7½ tons more than that carried when the original line *A* was made. In point of fact, line *D* brings the current below the sparking limit, and is within the capacity of the motor.

The total effect was not, however, confined to those named; for with the original arrangement, the current required to maintain constant speed was so great that the generator could not supply it. The result was a drop in pressure and in speed of motor. As matters now stand, the generator supplies current without difficulty.

Planers have, of course, been run successfully with plain shunt-wound motors, but only by having them of sufficient capacity to carry the heavy current required at reversal. With small machines the difficulty exists as with large ones, but does not cut so large a figure in dollars and cents. The amount saved in cutting a 5 horse-power motor down to a 3 horse-power would not be great, but the saving between a 50 and a 30 horse-power motor is another matter. The work on this machine is pioneer work in a field where good authority has said that electric motors were not suitable, and the Crocker-Wheeler Co. are entitled to credit, not only for the manner in which, through considerable discouragement they have hung to the problem, and for the sucessful conclusion to which they have brought it, but also for their liberality in supplying us with the facts and diagram here published.

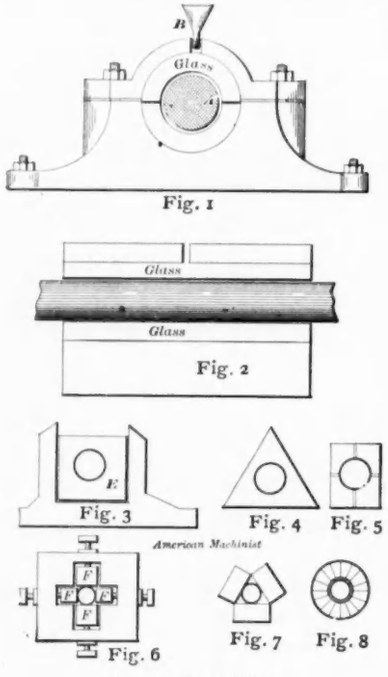
Letters from Practical Men.

Glass Machinery Bearings.

Editor American Machinist:

Glass sleeves for ordinary machinery bearings may be one of the next improvements in the mechanical line. Experiments with glass as a material for this work were tried some time ago, but it is only recently that practical tests have been made in the shops on running machinery with a view of ascertaining whether the glass would do. That glass presents a remarkably smooth surface, thereby reducing friction and saving oil, is well known. The perplexing question has been concerning the strength of the substance.

The writer has been interested with parties who have carried out some tests in a machine shop which proved that, for light work, glass possesses some valuable advantages, providing, of course, that the conditions are suitable. Some very heavy loads were put upon some bearings lined with glass sleeves; and although no accident occurred, there were shortly developed indications of breakage, and continued running would probably have resulted in disaster. The journals of the balance wheel of an idle engine were fitted with glass linings, only to be broken when the governor belt was slipped off and the engine permitted to run at a very high speed for a few moments. Glass sleeves were placed in a box which supported a heavy shaft, and it so happened that an old key seat occurred in the shaft, directly in the bearing, and the edges of this ground the glass material to powder after a short run. Some like tests with extra heavy shafts or loads, and under extraordinary conditions, proved that glass bearings were wanting in several qualifications.



GLASS BEARINGS.

At the same time, however, experiments were conducted under more favorable circumstances which resulted in showing that, for light work and high speed, glass is suitable. A common type of box, like that shown in Fig. 1, was taken and the bearings removed. Ordinary glass was melted and poured into the bearing pretty much on the same principle as is adopted in pouring babbitt metal. The box was previously prepared by chipping the surfaces of the interior so as to form a hold for the glass. The shaft was inserted and lined up in the center of the bearing, the ends of the box closed with iron fittings, and the melted glass run in through the funnel *B*. Before it became hard, the shaft was turned occasionally so as to free it from the glass. In order to divide the glass lining so as to permit the removal of the cap and take out the shaft, metallic pieces were fixed at either side of the shaft and extending the length of the bearing. The oil hole had to be drilled afterwards.

A sectional view of this bearing is shown in Fig. 2. This bearing has now been running several months with a 2-inch steel shaft, running 180 revolutions per minute, next a pulley of 18 inches diameter, and which drives a 4-inch belt; and the latter runs a machine which requires about 6 horse-power. The bearing does not require much oil, has not heated yet, shows no sign of wear, remains smooth and accurate, and appears to be a success. For experimental purposes, the belt was thrown off one Saturday night and the shaft run at one-third increased speed till Monday morning, without the journal indicating any change. Other forms of glass bearings which were either actually tried or put in readiness to try are also shown.

Fig. 3 is simply a square block of glass bored out to fit the shaft and adjusted in a square setting, the glass part being marked *E*. Fig. 4 is another type of solid block bored to fit the shaft and intended to rest in an adjustment made to suit the peculiar shape.

Fig. 5 shows a glass bearing made in four pieces and intended to fit in a common type of block.

A peculiar arrangement is shown in Fig. 6. Four adjustable blocks of glass fit in slots in the suitably shaped iron device, and those blocks *F* are regulated to correspond with the circumference of the shaft by means of the screws as shown.

By this plan, as in Fig. 7, the whole of the surface of the shaft is not touched by the glass, and, as the tests seem to prove, this makes as strong and as satisfactory a bearing as the former kinds.

Fig. 8 is a rather odd arrangement, and would evidently cost more to make than the others, owing to its being in sections, each of which must necessarily be very accurate in order not to cut the shaft. The idea of this plan is to present a series of surfaces to the shaft, each of which does its share of work; and in case of wear or breakage, part of the pieces may be saved.

Builders of heavy machinery will wisely let glass bearings alone for the present, but those concerned in making light machinery may find some use for them.

G. D. RICE.

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The Box-Frame Press—Pitman Connection.

Editor American Machinist:

In Mr. Randol's communication in your April 23d issue, he affirms that I claimed to be the first to use a box frame on punching machines. This is a rather broad statement, as in my article in your March 12th issue I merely spoke of designing a general style of press which contained other characteristic features beside the box frame, and which, as far as I could find out by examining English, German, French and American press catalogs, had never been put upon the market. It is, of course, likely that some presses with some kind of box frame have been occasionally built almost from time immemorial, but I think it will be found that the regular line of punching presses which the Ferracute Machine Company started to build some ten or twelve years ago, which they have built a great many hundreds of since, and which have been almost exactly copied both in England and America, were, as claimed, a new general type to be regularly made in quantities.

Mr. Randol further speaks of my "claim" to have broadly covered the globe-end pitman rod by a patent in 1886. In speaking of the subject I could obviously do no more nor less than simply state facts. The patent in question speaks for itself, and is, of course, available for the public to freely examine. I can only say that the pitman described therein, which did not limit itself to the spherical-end feature, but included a combination of that with a split pitman-strap sleeve, and a clamping bolt to give a grip upon the same, was original with me.

Since writing the article in question I have heard from another source beside Mr. Randol that such a pitman was used previous to the date of my patent, but I have not yet received any very definite evidence of the same. If such is the case it is, of course, only a common occurrence, where more than one person thinks of the same thing—an event especially likely to occur with so simple a device as this. If others were ahead of me it was perhaps my misfortune in being born too late, but from the fact of the Patent Office freely granting my claim without dispute I took it for granted that it was very likely to be new. If it was not new the case is simply another illustration of the carelessness of Patent Office methods. These, it is to be hoped, will be reformed some day, when the office is sufficiently equipped with money and men to thor-

oughly search the manufactories of the country for devices of this sort, that patents may not be issued upon things already in use.

What Mr. Randol says about the superiority of the box frame on account of its resistance to torsion is perfectly true, and this was one of the reasons for my adopting it, in addition to my desire for something of so greatly superior an artistic appearance.

OBERLIN SMITH.

Bridgeton, N. J.

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Ratio.

Editor American Machinist:

There has been a long discussion as to whether "ratio of a to b" was a divided by b or b divided by a. More than forty years ago Professor Davies, the author of "Logic of Mathematics" and of many text-books, made labored arguments to show that it was the second divided by the former; that is, b divided by a. One of his strongest arguments appeared to be that in a geometrical series like 2, 4, 8, 16, etc., it was admitted by all arithmeticians that the ratio was 2; that is, the quotient of any term divided by the preceding one. He was finally opposed, and I think successfully, by another writer who held that the language "ratio of a to b" implied that a was to be compared with b, that the ratio informed us how many times a contained b, which value was found by dividing a by b.

In regard to the geometrical progression, it is fair to ask whether the ratio is used in the proper sense, rather than build an argument upon an admitted practice. The use in that place may be an exception to its proper use. If one is to determine whether the sun moves around the world, the fact that we generally say that the sun rises and sets would not be used as the basis of an argument.

DE VOLSON WOOD.

Hoboken, N. J.

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Editor American Machinist:

I am glad to agree with Mr. Kent in his remarks upon "Ratio," in your issue of April 30th, dictionaries to the contrary notwithstanding. I think the full presentation of the subject is as follows: A direct ratio is a vulgar fraction, and an equality between two ratios constitutes a proportion. Thus, denoting the diameter of a circle by D, and its circumference by C, we have:

$$\frac{D}{C} = \frac{1}{\pi}$$

which reads: Diameter is to circumference as unity is to Pi. It may here be remarked that a proportion is best expressed in the fractional form, as above, instead of uniting the factors by a series of dots, as is commonly done.

To pursue the subject a little further, it will be seen that a direct ratio is represented by a division, and an inverse or cross ratio by a multiplication. Your excellent article on "Mechanical and Electrical Work," in the same issue, affords a good example of the latter, in the equality of work done upon two bodies of different weights, raised to different heights in equal unspecified times. Thus, denoting the weight of one body by W and the height to which it is raised by H, and by W^1 and H^1 the same elements of the other body, we have, under the above conditions of equality:

$$W H = W^1 H^1 \text{ or}$$

$$\frac{W}{W^1} = \frac{H^1}{H}$$

in which the factors in the right-hand member of the equation are inverted—hence the name "inverse ratio."

E. SHERMAN GOULD.

Yonkers, N. Y.

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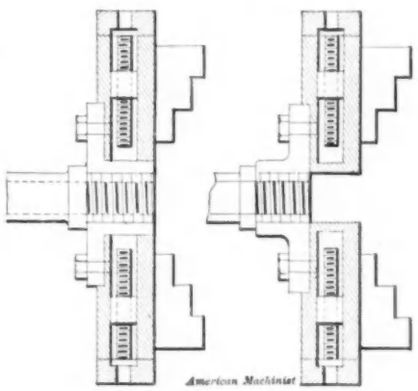


Fig. 1 NEW WAY. Fig. 2 OLD WAY.

Improved Manner of Mounting Lathe Chucks.

Editor American Machinist:

In a recent visit to a neighboring shop I found something that might interest your readers—it was so good that I adopted the change at once on our own work. It is with reference to hanging chucks on lathe spindles by reversing the collar flange, and by so doing getting the chuck and work in closer to the bearing, insuring a stiffer construction and better work. The accompanying sketches will explain.

JAMES D. ANDERSON.

Detroit, Mich.

▲ ▲ ▲

That Pump with a Single Stuffing Box.

Editor American Machinist:

In your last number there is a description of a German vertical double-acting pump, with outside packed plunger, and four valves arranged one above the other. You say that this pump will work just as well if the two upper valves are left out. I am inclined to think that you are mistaken about this, as there is a passage from the chamber below the second valve from the top, which passage connects to the suction pipe; so that if this second valve from the top is taken out, the discharge space will be in connection with the suction pipe, under which conditions the pump, of course, will not work.

Again, if the top valve was taken out, then the pump would be converted into a single-acting one; while with the four valves in, it is a double-acting pump.

The writer is very familiar with this design, as he invented and built such pumps in 1892. A description of one of these pumps can be found in the "Engineering News," No. 9, of this year, page 143. The design is identical with the one illustrated by you, with the exception of the arrangement of piston packing. I should think a piston packing such as on your German pump would not be very successful, as it would suffer too much from sand and grit in the water. I have been using packings of this kind repeatedly on tandem compound engines, between the two cylinders, and found the arrangement very successful. It is a very convenient arrangement to use in converting simple engines to tandem compounds, when the room available for the second cylinder is limited.

BRUNO NORDBERG.

[We are constantly reminded of the thoroughness with which the "American Machinist" is read. We have already received other communications upon this subject, and pointing out the error of our ways. As the suction passage supplying the upper chamber was not fully shown, we too hastily concluded that the pump was practically the same as that shown in our issue of March 19th; but when the suction passage is understood, it is evident that the two upper valves are quite as essential to the full action of the pump as the lower ones.—Ed.]

▲ ▲ ▲

An Improvised Gear Cutter.

Editor American Machinist:

Recently, in the shop here, a radial drill press was undergoing some repairs, and amongst other things some miter and bevel gears had to be renewed. Not wishing to send out for them, and not having a proper machine to cut them, the question arose as to how they were to be produced. So after the foreman and one of the planer hands had put their heads together, it was decided to rig up something like the accompanying sketch, which explains itself.

The blanks were turned up and a line turned both inside and out, corresponding to the root of tooth, as to a and b.

The piece marked "carrier" was machined so that when resting on an angle plate one end, and on the planer head the other, and bored out to receive an arbor as shown, the bottom of tooth that was directly under the planer tool stood parallel with surface of bed.

The arbor had a pressed fit into the blank and a nice rolling fit in carrier.

The spur gear underneath was chosen

from one of the lathes, and in this particular case had just twice the number of teeth required in the blank. This was also firmly secured to arbor.

Fig. 2 shows side and top view of a block and sliding stop, which was fastened at a suitable place onto bed, as at *x*, Fig. 1. One end of stop was shaped to fill a tooth space and to take up all lost motion in the spur gear.

The planer tool was shaped to conform

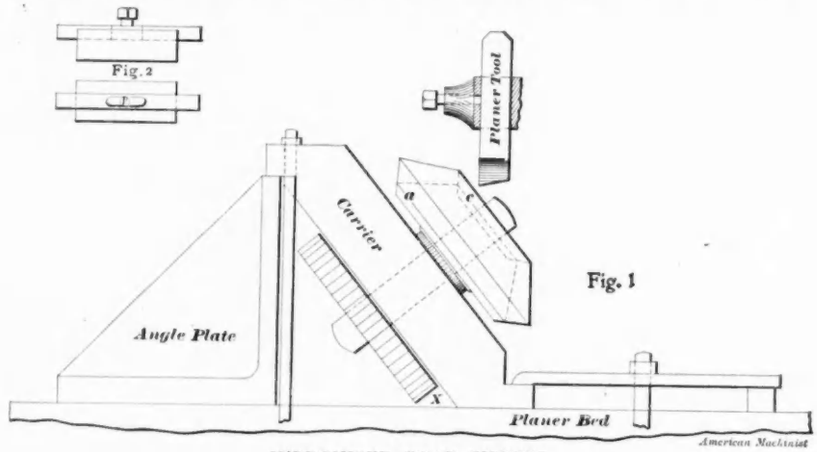


Fig. 1

IMPROVISED GEAR CUTTER.

to the teeth at the outside of blank to be cut, and after going once around, the tool was brought a little to one side to give the proper clearance. Of course, it had to be moved both right and left to have the teeth stand radial. I do not suppose the curves of teeth were absolutely correct, but it made a pretty good job just the same.

In one case the number of teeth to be cut was such that it was necessary to compound, so a second arbor was made and spur gears mounted to enable the blank to be divided properly. The stop above referred to was made to engage in one of the two gears on the secondary arbor.

Thinking, perhaps, it may help some of your readers to overcome a difficulty when in a pinch, I was induced to send it for publication. I should have said that the tool was fed down, by hand.

WM. NEWTON.

Oneonta, N. Y.

▲ ▲ ▲

Poor Vacuum After Compounding.

Editor American Machinist:

Inclosed please find sketch of arrangement of piping from low-pressure cylinder of our engine. The engine was until five years ago a pair of 16-inch, but one cylinder was taken out and the 32-inch put in its place. They used to get a good vacuum until the engine was compounded, but since then have been able to hold from 14-inch to 16-inch only. I made a test a few Sundays ago for leaks, and by getting everything tight we got about 20-inch. You will see by the sketch how the cylinder is piped to the condenser. No. 4 is 12-inch pipe, and in that are six lengths of 2-inch pipe arranged "trombone" style for a feed-water heater. You will see that the 8-inch pipe leads to a Bulkley injector condenser, and in the condenser is a cone about 6-inch diameter at the small end.

The only change that was made in the piping when the engine was compounded, was to put in the 12-inch pipe as far as the heater. The heater was not disturbed.

They seemed to think that as the exhaust pipe would take care of the steam with the two 16-inch cylinders, and the engine would only be doing the same work, of course there would be no need of a larger exhaust pipe. If you will make a few figures you will readily see that the exhaust steam has a velocity more than double what it should have, and I tell the owners that the vacuum will be no better until the exhaust pipe is enlarged so as to relieve it, and that they ought to put in at least all 11-inch pipe and a larger condenser.

You will see that the 8-inch pipe was large enough for the two 5½-inch pipes from the pair of 16-inch, as it gave a velocity of only 4,000 feet.

I would like to have your opinion through the columns of the "American Machinist."

PROVIDENCE.

[The exhaust pipe is certainly very small for a 32-inch cylinder. The size should be not less than 11-inch, as suggested by our correspondent. If, as we judge from the sketch, the condenser is suited to an 8-inch pipe, it also is doubtless too small. It is not easy to see why the vacuum decreased with the compounding of the engine, provided no change of load occurred at the same time. The change was made five years ago, however, and one's memory is not always to be depended on for that length of time. The loss of vacuum may have come about gradually with increasing load, or some other cause, such as leaky pipes, may have been responsible at first, and this cause may now have disappeared. There can be no doubt that the pipe, and probably the condenser also, are too small for the present cylinders. A pair of pressure gages inserted, one in the bend of the condenser, and the other in the exhaust pipe near the engine, would show the loss due to the small pipe, but not, of course, that due to insufficient capacity of condenser.—Ed.]

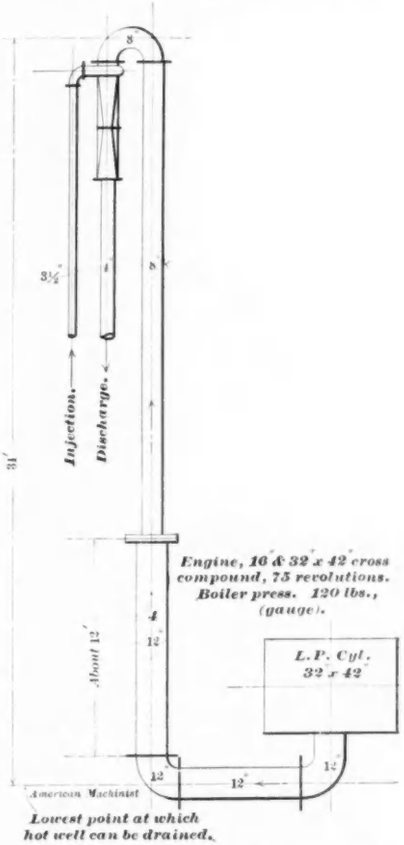
▲ ▲ ▲

I Was the Engineer.

Editor American Machinist:

After I had been at the Marine Engine Works about a year or so, business was looking pretty blue. It was just before the panic of '73, and we weren't selling many engines, and I heard of a chance as engineer up at the Bay State Tool Works. I thought I would like to stop working awhile and run an engine. I had had a good deal of experience at it while I had been in the shop, and the "Old Man" had tried his best to get a few ideas on the subject into my head; so I spoke to him, telling him of the chance and asking him if I hadn't better look the job up. He said work was slack and if I wanted to try it he would give me a good send-off; so that night I went up to see the Bay State superintendent. Well, he took me into the office and gave me a long lecture on the duties and the responsibilities of an engineer, and the number of lives I held in my keeping. Well, the long and short of it was, I went up there to work the next Monday.

I had two large boilers to fire, and



POOR VACUUM AFTER COMPOUNDING.

three large pumps beside the engine and boiler pumps to look after. The coal

was dumped into the fire-room, but I had the ashes to wheel out.

The small feed-pump would not quite keep the water line up, so about once in the forenoon I would start the big pump and fill the boilers up as high as I dared to, and then use the feed-pump again. I got along pretty well, and one day the superintendent came around and I was taking it easy in the fire-room; he looked around a while, then said he guessed I had better wheel the ashes out toward the street and make a good sidewalk; said I seemed to have a good deal of spare time on my hands; so, like a fool, I started in.

I got the walk built out some three or four hundred feet, and one day, when I had just started the big pump, the superintendent called me out and said I didn't grade the walk just as it should be. He kept me there ten or fifteen minutes, and when I got back there was no water to be seen in the glass in either boiler; it was away up in one and away down out of sight in the other (we did not pump into both boilers at once). What did I do? I ought to have pulled the fire out, but I didn't; I changed the feed into the other boiler and ran the pump for all it was worth until I could see the water in the glass (it seemed to me an hour), and then I shut off the pump and blew off the water in the other boiler until it came in sight again. Then I breathed once more. How near I was to the other world I never knew, but no more sidewalks did I build. I told the superintendent the heat and excitement was too much for me, and I would like to go into the tool-room. He was very good; said if a little more money would help me stand the heat he would give it; but I said "No" and I went into the tool department.

He put Ben in my place; he had worked around the boilers a good deal and could shovel coal, and start and stop the engine. They used to want me to carry the pressure higher than the boiler inspector wanted us to, and I would not do it; but Ben said he was not afraid—said he had seen a boiler only three feet high and it held sixty pounds of steam, and it stood to reason that a big boiler like that would hold eighty pounds or more. No words of mine could convince him of his error, and as I was out of it I let him go ahead.

I stayed at the Bay State a year, but I did not run boilers or build any sidewalks.

I will write again some time and tell you how Ben made out.

A. P. PRESS.

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Breaking Dies—A Remedy.

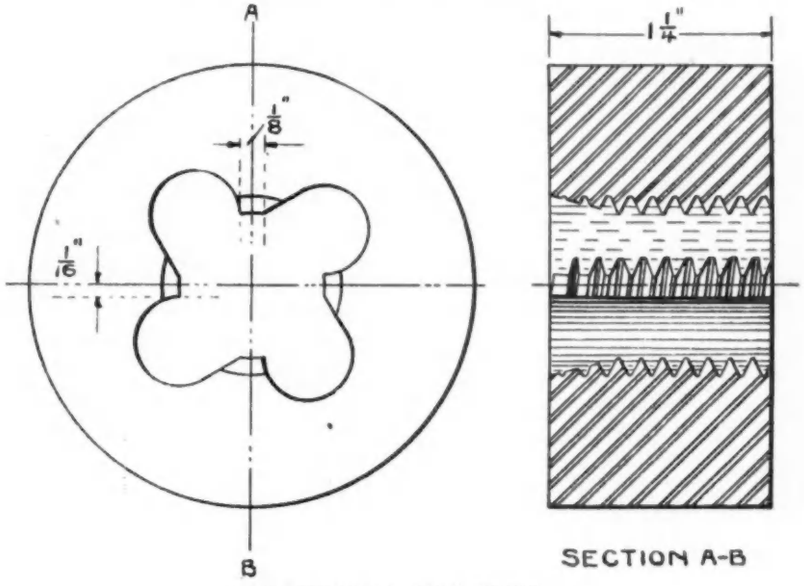
Editor American Machinist:

If your friend "Monitor" will make his dies of the form shown by acccompanying sketch, I believe he will obtain very satisfactory results from them. I have known dies of this form to last from twenty to thirty days, with constant use for ten hours per day.

You will notice there are four teeth to the die instead of five. The teeth are $\frac{1}{16}$ inch ahead of the center, and are backed off three full threads. I believe these three points will obviate all breaking of dies, and especially the four teeth in place of five—an even number of teeth is much better than an odd.

His temper I believe to be about right. If the job can afford it, use lard oil to cut in.

Dimensions given are all for 1-inch bolt,



A RECOMMENDED FORM OF DIE.

except the $\frac{1}{16}$ inch ahead of center, which is proper for all sizes of steel from ½ to 1-inch inclusive.

TREB.

▲ ▲ ▲

Annealing Steel.

Editor American Machinist:

In regard to annealing steel, will say there is no better thing than charcoal. Start your coal afire, and put your steel in layers in the coal; and when it gets to a good red, close your furnace up tight—say as tight as a stove will close by closing the pipe tight—and let all get cold together; the longer in getting cold the better.

Very common grades of steel will be nearly as good as P. S. Stubbs' steel. It will harden harder, and you can draw the temper lower and make the steel tougher than any other process that I know of.

W. J. H.

▲ ▲ ▲

Chas. W. Whitney, of New York, who is agent in this country for Serve tubes for boilers, has an article in the "Railway Review," in which article he claims that by the adoption of these tubes the railways of this country would save $100,000,000 per annum, and he asks us to comment upon the matter. Mr. Whitney gets his results by assuming that the number of freight cars that can be pulled over a road by a given locomotive is always limited by the capacity of the boiler to make steam, that the Serve tube will increase this capacity, and therefore more cars can be hauled, and consequently more money earned, by each locomotive in actual use; and to make up his $100,000,000 he counts all the locomotives in use in the country.

Some fault might be found with this method of computing the economic results, though it is a fact that the Serve tube has given good results in evaporative tests. Whether it would do well in locomotive service in this country, or not, is a problem; and even if it did, there are plenty of locomotives that make, without difficulty, all the steam required for the service they are in. For such locomotives the only possible gain would be by saving of coal in doing the same work; and computed on this basis, the $100,000,000 would have to be scaled down considerably.

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Death of Hamilton Disston.

Hamilton Disston, the head of the great saw works of Henry Disston & Sons, of Philadelphia, was found dead in his bed upon the morning of April 30th. Mr. Disston was born in Philadelphia in 1844. His education was completed in the public schools of the city. He entered his father's shops and learned the details of the work, but was never distinguished mechanically. Upon the death of his father, in 1878, the control of the business passed to him and his brothers, Horace C., William and Jacob S., who became incorporated as Henry Disston's Sons, the deceased, as the eldest son, and also representing his mother's interest, becoming the head of the corporation. The factory employs 6,000 men, and has an output annually of 70,000 circular saws, 2,000,000 hand saws, 5,000,000 files, and large quantities of other tools.

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The Electrical Exhibition.

The Electrical Exhibition, now being held at the Grand Central Palace, is one of the best exhibitions ever held in this city. The usual trifling features of such shows are conspicuous by their absence, while, at the same time, features of distinctly popular interest are not overlooked. The telephone exhibit, bringing the roar of Niagara to the visitor's ear, in connection with the working model of the great power plant at the falls, and the operation of some of the exhibits from this source of current, are features which form centers of attraction to large numbers.

The exhibition is confined more closely to exhibits having a direct bearing upon the avowed purpose of the exhibition than is usual, and the many applications of electricity which are shown, illustrate in the clearest possible manner the extent to which electricity has come to be a factor in our daily life.

Young as is the development of electricity in most of its applications, it has already an "ancient" history, albeit its pioneers are still mainly in the enjoyment of hale and vigorous manhood. The historical exhibits cannot fail to impress the visitor with a sense of the painful and laborious nature of progress—even in a field where progress has been of such unexampled rapidity as this. The many models of early incandescent lamps tell most eloquently of the extent of the effort required to perfect even such a seemingly simple affair as this, and the Patent Office models tell the same story of other electrical apparatus. One man sows and another reaps, and only by the combined efforts of many who are forgotten in the final result, is final success attained. It is, doubtless, true that no single mind ever brought any great invention to perfection, and nowhere can this fact be better realized than at this exhibition. From whatever point of view one may be interested in electrical matters, all should see this great show, and few earnest minds will be satisfied with a single visit to it.

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Paying Wages By Checks.

Is there any good reason why men who work in industrial establishments and for railroad companies should not generally be paid by checks on local banks instead of in currency? Are there not a number of excellent reasons why they should be paid by checks instead?

The subject is suggested by seeing a few days ago a newspaper item to the effect that a Western firm had been having trouble with its employés, who, in fact, struck because they were paid in checks instead of currency, as previously.

Believing that cheeks ought to be better in most every respect for such payments, we inquired into this matter, and in reply received a letter from the secretary and treasurer of the concern, * Mr. C. W. Stiver, in which he says:

"Regarding our adoption of the check system of paying our men, would state that our objection to paying cash is about as stated. * * * * Our pay rolls are rather large, amounting to about $50,000 per month, and we do not care to handle this amount of currency, especially when it is entirely unnecessary and no one is particularly benefited by it. * * * * Our checks are made payable to bearer, not requiring indorsement or identification, and pass as cash at any of the stores or banks here, thereby relieving the men of any trouble or the necessity of presenting them at the particular bank on which they are drawn.

"After the new system had been tried the first time, the men experienced no trouble on account of it, and we have since heard no complaints from them, although we have been paying with checks for the past six weeks. We believe this is the only proper method of paying and is much better for all concerned than the system of paying cash."

It is, and for some time has been, our belief that, so far as possible, wages should be paid in checks, the same as other debts are now mostly paid.

A merchant or professional man invariably prefers that payments should be made him in checks signed by responsible parties rather than in currency. The check is clean and free from disease germs; it pays the exact amount without bother of making change or inclosing silver; it forms a record of the payment; is much more easily recovered if lost; is attended with very much less risk of robbery; and finally, best of all, as it seems to us, it would make workingmen participants in the grand system of commercial credits which forms the basis of business transactions, and which enables an amount of business to be handled entirely without the direct use of money that could not possibly be handled by the use of it, and which forms what is virtually a currency that is nearly perfect and which automatically contracts and expands exactly as it is needed.

Men do not work for money, but for those things which money will buy; and it is a familiar fact that those who have the largest incomes and have the most of those things that money buys, actually handle comparatively little currency and do not wish to be bothered with it. They receive payments in checks and pay bills by the same means, and find it in every way advantageous to do so. There is no good reason why workmen should not partake of this advantage and in fact if, by the establishment of branch banking houses wherever needed, or in any other way arranging for taking care of smaller accounts than are now commonly dealt with by banks, intelligent mechanics could be induced to make general use of the banking system, it would, we are confident, be better for them and better for business generally.

The men in West Bay City seem to have found no valid objection to checks, and we think their advantages will be apparent to all who try them.

* F. W. Wheeler & Co., West Bay City, Mich.

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The paper upon "The Mobility of Molecules of Cast Iron," an abstract of which appears in this issue, would seem to be well deserving of the attention of a wide class of our readers. The results given, upon evidence which may not be challenged, upset theories or notions that have prevailed for ages. Our interpretations of the relations of causes and effects are often at fault, but the effects themselves are not usually so entirely misunderstood as they are shown to be in this case. The line of investigation here opened seems to be full of promise of richer relations in the near future.

▲ ▲ ▲

Col. F. K. Hain, general manager of the elevated roads in New York City, who was killed by the cars at Clifton Springs, N. Y. on the 9th, started in life as a machinist in a railroad shop, and by sheer ability to do a prodigious amount of work rose to eminence as a railroad manager. Previous to the accident which terminated his life he was in ill health, resulting from overwork, and was endeavoring to recuperate.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(102) P. J. D., Montreal, Can., asks: 1. What is the best preparation to use to prevent the dampness of the sand from penetrating wood patterns? Is there anything better than shellac? A.—From the practically universal use of shellac for wooden patterns, we judge that nothing better is known for the purpose. The use of lampblack with the shellac is generally condemned as being only a device for concealing bad pattern work, but we are inclined to think that it also helps to make the shellac more effective in protecting the pattern. We would be glad to receive evidence upon this point. 2. Does it make any difference whether the shellac is mixed with grain alcohol or with methylated spirits? A.—As the solvent simply evaporates and leaves the deposit of shellac, we do not see how it can make any difference.

(103) A. L. E., Louisville, O., writes: A pump having a 1½-inch discharge pipe running to an elevation of 60 feet has nine or ten L's, and there is a pounding all along the pipe, causing great annoyance. Please state a remedy for this if possibl. A.—With the above meagre information it is obviously impossible for us to suggest the cause of the trouble or the way to cure it. We do not know the size or speed of the pump, and so whether the pipe is as large as it should be or not; we do not know what horizontal runs it may have in addition to the vertical lift, or whether it has any downward pitches in it or not. It is evident that the column of water is not solid, nor the flow of it steady. A larger air chamber might help the case; also, the suction pipe may be leaky and should be doctored, or the pump may be run so fast that the flow of water cannot follow the piston and completely fill the cylinder at each stroke. In a line of pipe the hammer may be anywhere along the line, and it is often difficult to locate the precise spot where it occurs.

(104) C., Chicago, Ill., says: A drum 12 feet in diameter, weighing 9,000 pounds, is provided with a brake ring 14 feet in diameter, weighing 6,000 pounds, the drum flange being bolted to the arms of the brake ring. Suppose the drum to have a velocity of 50 feet per second at the circumference, and it is stopped by means of the brake in one-half of a revolution. What is the strain in pounds on the arms of the brake ring where the drum is attached? A.—The problem cannot be answered exactly without a knowledge of the disposition of the metal of the drum and the distance from center of shaft to the bolts between drum and brake ring. An approximate solution is as follows: Assuming the metal of the drum to be concentrated at its outer circumference, and calling W the weight and v the velocity, we have:

$$\text{Stored energy} = \frac{W v^2}{64} = 351{,}500 \text{ foot-lbs.}$$

This energy must be absorbed in moving one-half a revolution, or, at the circumference of the drum, 18.85 feet. If the resistance of the brake ring is constant during the retardation, the force exerted at the circumference of the drum is

$$\frac{351500}{18.85} = 18{,}700 \text{ pounds.}$$

The matter may be looked at in another way.

Let p = acceleration (negative) during the stopping;

Let s = space covered in stopping;

v = velocity before stopping;

W = weight of drum;

F = force exerted at the circumference of drum.

Then, assuming, as before, the weight to be concentrated at the circumference of the drum, and the retardation (negative acceleration) to be uniform, we have:

$$p = \frac{v^2}{2s} = \frac{2500}{37.7} = 66.3 \text{ and}$$

$$F = \frac{W}{32} \times p = \frac{9000}{32} \times 66.3 = 18{,}700 \text{ lbs,}$$

as before. The weight of the brake ring is not a factor in the problem. That weight is a factor of the pull on the brake strap, but has no influence on the strain on the bolts connecting brake ring and drum.

(105) L. J. R., Meadville, Pa., writes: I saw a rule in your paper for setting a compound rest to bore a taper ⅛ inch in 3¾ inches. The answer called for 2 degrees, and I bored out a hole by that rule and it came out all right. Now I want to bore a hole 2 inches in 3¾ inches. The rule called for 11 or 12 degrees; but I had to set the rest 15 degrees to do the job. Will you please explain? A.—We do not know where our correspondent found the rule referred to; and whether the rule was right or wrong, our correspondent is evidently wrong in the use of it, for an angle of 2 degrees will not give a taper of ⅛ inch in 3¾ inches. For boring or turning tapers with accuracy, the graduations by degrees are not sufficiently minute to be of much service; but when such computations are undertaken, it is well to have them as correct as possible, and they may sometimes serve in checking or watching operations. To ascertain the angle to set over the rest, we would first divide the difference in the diameters of the ends by the length; this would give us the chord of the arc corresponding to the angle of the taper, and from a table of chords the angle would be readily ascertained, and one-half of this angle would be the angle required for the set-over of the rest. The first case cited by our correspondent (converting all the figures into decimals) will give us: $.125 \div 3.75 = .0333$, and in a table of chords we find .0332 for an angle of 1° 54′, and one-half of this, of 0° 57″, or a little less than one degree, would be the correct set-over. In the second case by the same operation we have: $2 \div 3.75 = .5333$, and by the same table of chords this corresponds to an angle of 30° 56′, and one-half of this is 15° 28′, or nearly fifteen and a half degrees. It is evident from this, that with no means provided for indicating minutes, the graduations of the compound rest are not of much account in setting for tapers, except as a means of approximating.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 26.

Forming Lathes, Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Honest Mach. Oils. F.S. Pease Oil Co., Buffalo, N.Y.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Bevel and miter gears cut with perfect planed teeth. Boston Gear Works, Boston, Mass.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Practical Guide for Firemen, by Wakeman; 80 pp.; 75c., post free; Am. Indus. Pub. Co., B'port, Ct.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

Duplex and special gear cutters, counterbores cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

For Sale—A fair sized foundry and machine shop with additional land, in good condition and well equipped for medium heavy work; located on a railroad; within eight miles of New York. Can be seen in operation for few weeks only. Owners giving up business. Terms easy. Call or address Room No. 41, 22 William street, New York.

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The Patent Office Report.

The annual report of the Commissioner of Patents for the calendar year 1895 was submitted to Congress May 4th. It embodies not only a full report of the business of the year, but also an interesting review of the growth of the industrial arts for the past quarter century. The Patent Office always pays its expenses. Since 1861 there has been some surplus in the Patent Fund every year. The most interesting items for 1895 are as follows:

Receipts	$1,245,247
Expenditures	1,084,496
Patent Fund in Treasury	4,529,886
Total applications filed	46,899
Patents issued	21,998
Issued to foreigners	2,049
Re-issues	59
Forfeited for non-payment of final fees	3,428
Trade-marks registered	1,829
Patents expired	12,345

The States securing the highest numbers of patents were:

New York	3,539
Pennsylvania	2,270
Illinois	1,876
Massachusetts	1,793
Ohio	1,423

In proportion to population the list runs quite differently: Connecticut is first, with one patent to every 927 persons; then come in succession the District of Columbia, Massachusetts, Rhode Island, New Jersey, New York, Montana and Colorado. At the bottom of the list is Mississippi, with one patent to 34,854 persons; then come South Carolina, North Carolina, Alabama, Georgia and Arkansas.

The principal foreign patents were distributed as follows:

England	614
Germany	539
Canada	302
France	202
Scotland	50
Austria-Hungary	46
Switzerland	42
Sweden	30
Russia	29

In the past twenty-five years there have been 25 inventors who have each obtained more than 100 patents. Some of them are as follows:

Thomas A. Edison	711
Elihu Thomson	394
Francis H. Richards	343
Edward Weston	274
Charles E. Scribner	248
Charles J. Vanderpoole	244
Rudolph M. Hunter	228
George Westinghouse	217

The Commissioner recommends the enactment of the bill prepared by the Patent Committee of the American Bar Association, and now before Congress, limiting the time within which an application may be made in this country, by either the foreign inventor or any other, to two years after the matter has been patented or described in any printed publication in this or any foreign country, and reducing the period within which applications shall be completed and prepared for examination from two years to six months.

The report also recommends an enactment to secure admission to a solicitors' bar of those entitled to practice before the office, the exclusive admission of lawyers being a manifest injustice.

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The Growth of Wages.

United States Commissioner Carroll D. Wright, in a recent bulletin of the Department of Labor, gives some comparisons of the wages rates in the United States in the past 40 years. There has been a widespread impression that the employer of labor gets an excessive share of the fruits of it, and Mr. Wright avowedly writes to controvert this. The average wages of employés in the manufacturing and mechanical industries were in 1850, $247.38; in 1860, $288.94; in 1870, $302.08; in 1880, $346.91; and in 1890, $444.83, the last decade showing the greatest proportional and actual increase. In 1890 the value of the gross products, manufactured and mechanical, was $2,204 per capita, or for the above, $444.83 of wages, so that of the total product 20.18 per cent. went to labor, while in 1880 only 17.7 per cent. went to the worker. It seems to be an indisputable fact that to-day the workingman gets more money for his labor, and also more of the products of all labor for his money. If he did not get some of the fruits of the world's progress he might well feel discouraged, while such a showing as the above should still give him heart to work.

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Mr. Edison having bought back his phonograph patents, has brought out a new machine. The principal change is in the introduction of a spring motor, in place of the electric motor formerly used. This change has shown itself to be advisable from the fact that many people are still out of reach of street currents, and at the same time will not bother with batteries of their own. The new machine takes the same cylinders as the old, and, except for the motor, is otherwise similar to it. It is expected to prove a formidable rival to the music box, with its limited assortment of airs, and it can be arranged to inscribe cylinders as well if desired.

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From the report of the British ordnance factories for last year the cost of the various types of guns is gathered. A 13.5-inch gun, without sights, cost $51,275; a 12-inch wire gun, without sights, $71,740; a 6-inch gun, $5,000; a 6-inch jointed gun, $8,185; a 30-pounder, 20 hundred-weight, gun, $2,300; an 8-inch experimental howitzer cost $6,825; a 6-inch experimental howitzer, $3,805; a 5¼-inch experimental howitzer, $3,435; a 6-inch quick-firing gun, without sights, $7,160; a 4.7-inch quick-firing gun, $3,280; and a 4-inch 25-pounder wire gun, $7,085.

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Commercial Review.

NEW YORK, SATURDAY EVENING, MAY 9th.

Engines, Boilers and Pumps.

The month of April passed away in a manner very unsatisfactory to the New York trade in engines and boilers, and from the standpoint of many leading concerns, the reports of continued quietness are unequivocal. There seems to be no explanation to offer for it beyond those that have been given time and time again. There have been no recent exhibitions of jingoism nor any unusual ground for public excitement beyond the rising tide of politics, but there still exists a hesitancy and lingering policy upon the part of buyers.

It is undeniable that some concerns talk of good and increasing business, but while so many of high standing complain of just the reverse, the market cannot be considered as in a profitable condition.

In this city, there is enough building, at the present season, to create something of a demand for steam plants for electric lighting, running elevators, etc. This constitutes an important part of the sales of some sellers, yet it seems insufficient, alone, to create any great activity in the market. An industry from which the demand is now slack, is mining.

As to the trade in steam pumps, some of the reports are of the same nature as those regarding engines and boilers. One company, indeed, did an excellent business during the month of April. Marine pumps are still spoken of as one of the prominent features of the trade, and, of course, there is some demand at this season for pumps for waterworks purposes.

Here are a few reports of the business experiences of some engine manufacturers. One company write us: "During the past month, we have received orders for a number of Corliss and automatic engines, but prices are very close, and there is little or no profit in these lines. Our business has been somewhat better than during April, 1895, but cannot say what percentage of increase. We are receiving a number of inquiries for heavy Corliss engines, but understand a number of the builders are short of work, and this will probably lead to low quotations, and we do not believe there will be any improvement in prices." They add that in some other lines of machinery their business has been much better than a year ago.

The Hooven, Owens & Rentschler Co., Hamilton, O., say: "We have been exceedingly busy during the entire year, running our works night and day, on Corliss engines. Our orders for April were fully as many as for March, the demand seems to be as great now as at any time during the year; the prices, however, are very low, although we have in-

(Continued on page 21.)

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Young draftsman wants position. Address P. S. C., AMERICAN MACHINIST.

Foreman boiler maker wants position. A 1 references. Address I. J., AMERICAN MACHINIST.

Mech. engr. and exp. draftsman, a Scotchman, 38 years of age, wants position. BOX 108, AM. MACH.

Mech. draftsman with 8 yrs. exp. in marine engineering wants position. Address G. Y., AM. MACH.

Mechanical assistant draftsman is open for engagement. Best references. G. L., AM. MACHINIST.

Situation wanted by experienced mechanic and skilled draftsman. Address Tool, AM. MACHINIST.

Pattern maker, first-class, wishes position, foreman or otherwise. A1 refers. BOX 115, AM. MACH.

Experienced draftsman wants position on gas engine work. Designing or as assistant to inventor. Address BOX 114, AMERICAN MACHINIST.

Wanted—Two draftsmen, aged about 35 years; those exper'd in automatic mach. and hopper feed work preferred. BOX 107, AMERICAN MACHINIST.

Wanted—Pos. as draftsman by tech. grad., with shop and drawing office exp. (21 years). Norwegian. Salary no object. BOX 116, AMERICAN MACHINIST.

Wanted—A man who has had experience in the manufacture of duplex steam pumps, to take charge of a shop employing from 30 to 40 men. Address Duplex, care AMERICAN MACHINIST.

Position as foreman machinist by thorough mechanic of 18 years experience, 8 as foreman on general machinery and repairs. Good references. Address BOX 112, care AMERICAN MACHINIST.

Wanted — Experienced mechanical draftsmen, North and West, having evenings free. State where regularly employed. Edwin Guthrie, Patent Attorney, Corcoran Building, Washington, D. C.

A very practical and mechanical engineer for laying out and erecting new steam plants is open for engagement; many years' experience; 38 years old. Address Practice, AMERICAN MACHINIST.

Wanted—A technically educated draftsman, experienced on steam hoisting machines and electric power plants, etc. Address, with full outline of exper. and list of references, BOX 117, AM. MACH.

Graduate of leading technical school, 6 years practical experience, 4 years in shop and 2 in drafting-room, desires to change position, could invest $2,000. Address R. C., care AMERICAN MACHINIST.

Wanted, position by young man having 5 years' experience with one of the largest machine companies in the country. Shop work not wanted. References given and required. Box 111, AMER. MACH.

Steady position wanted by thoroughly practical and up-to-date pattern maker (Swedish); 8 years' experience with leading manufacturers in this country. Best of reference, sober, and willing to work. Address J. N., AMERICAN MACHINIST.

A large tool factory wants a thoroughly experienced engineer with college education and who is capable of acting as substitute for the technical director. First-class men will send their applications, stating course of study, previous positions and references under S. 6148 to Rudolf Mosse, Vienna, to be forwarded.

Wanted – Foreman, an educated, thoroughly practical and experienced machinist; must be up to date on rapid process interchangeable work; must have a record for handling men and pushing work out rapidly. Right man can grow. Enclose list of references and state salary required. Address Box 118, AMERICAN MACHINIST.

Wanted—A man to act as traveling representative for a favorably known tool builder, to sell a labor-saving machine; previous experience as salesman not necessary, but good habits, good address, exp. in machine shop work and management required. Answers confidentially treated. Give full particulars as to previous ex. Box 105, AM. MACH.

Draftsman & mech. engineer, exp. in all branches of mech. engineering, plain structural work, expert in designing and constructing machinery, has reliable executive ability combined with excellent mech. & tech. knowledge, is resourceful & quick; wishes steady pos. of responsibility where brains & talent are appreciated. Address Box 119, AM. MACH.

Wanted—A first class "all around" modern machinist, who has had some experience as foreman, and been a success as same, to work in shop, and act as foreman in shop manufacturing medium heavy machinery. To the right man, who is up with the times and can fill the place to our satisfaction, an excellent opportunity to prove his value is offered. Address Box 110, AMERICAN MACHINIST.

Wanted—A first-class designer and draftsman on experimental shoe machinery, capable of working out the ideas of an inventor and carrying the design of machine through to a practical conclusion, so that it can be manufactured and look like a modern machine. None but a thoroughly experienced man, both in the shop and as a designer need apply. One familiar with sewing machine work preferred. Please state full particulars and lowest actual wages desired. Box 109, AMERICAN MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

For Sale—Good 3 H. P. Springfield gasoline eng. cheap. Frank H. Chisholm & Co., Bloomington, Ill.

For Sale—5,000 half-worn drills and taps at 1 cent each. Send stamps for samples to J. L. Lucas, Lynn, Mass.

For Sale—Two Warner & Swasey speed lathes, in first-class condition. Penberthy Injector Co., Detroit, Mich.

Wanted—Partner with about $1,500 for the manufacture of light machinery. Shop established. Box 113, AMERICAN MACHINIST.

For Sale Cheap—1 No. 2, 11-inch stroke Morton key-seater. Has key making and binder attachment. Been used less than 30 days. Address, The Gardner Governor Co., Quincy, Ill.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call or get list 17 B. The Garvin Mach. Co., 440 Canal st., N. Y.

For Sale—Modern machine shop with foundry, blacksmith and pattern shop; situated in one of the largest cities on great lakes; dock and rail facilities. A rare opportunity for right party. Address J. A. C., AMERICAN MACHINIST.

VALUABLE BOOKS

For MACHINISTS, ENGINEERS, ELECTRICIANS, Etc.

Our catalogues of Books, on the above subjects, as well as every other practical subject, sent free to any address.

☞ See our detailed advertisements of special books in recent numbers of AMERICAN MACHINIST.

NORMAN W. HENLEY & CO.,
15 Beekman Street, NEW YORK.

MANUFACTURING SPECIALTIES.

Dies, Tools, Models and Special Machinery.
MILLING AND PRESS WORK.
Electro-Plating of all kinds.
SATISFACTORY WORK GUARANTEED.
THE PARK MFG. CO., 920 Elm St., New Haven, Conn.

STERLING CLAMPS.
Steel, deep threads on screw give purchase. 2½ in., **55c.**; 3 in., **70c.**

HAND VISES.

Black. Bright Jaws.

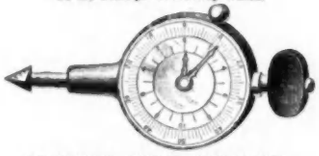
STUBS' HAND VISE.
3 in. Retail, $1.00; our price, **79c.**

HAND DRILL
with drills in hollow handle, 3 jaw chuck. Should be in every tool chest. Retail, $1.25; our price, **93c.**

CALIPER SQUARE.
Reads to 64ths and 100ths; 4 in. long, **$3.37**; 6 in., **$3.75.**

ALBRIGHT'S WRENCH.
Can be operated by one hand; furnished with toothed or smooth inserted jaws. 8 in., **$1.13**; 13 in., **$1.22.**

The Standard Speed Counter.
On the Principle of the Stop Watch.



STANDARD SPEED INDICATOR.
Adjusted to run upon touching trigger. Point affixes itself to an irregular center. Retail, $6.00; our price, **$4.49.**

FREDFRAS FILE CARDS.
Carding of first quality; being held by wire, handle will not loosen. Per dozen, **75c.**

Avail yourself of these bargains. We are also headquarters for **Bicycle Repair Tools.** Send 20c. for *Illustrated Catalogue* which we will refund on first order.

T. H. E. FRASSE CO.,
19 WARREN STREET, Near Broadway, N. Y.

creased our prices over last year to some extent."

Another concern says: "We have had less business in April than during the month of March, and also less than a year ago. Our engines are sold almost entirely for electrical work, and there are very much fewer electrical plants being put in at the present time than a year ago. Most of the engines being installed at present are for isolated plants for office buildings, public institutions, stores, etc., and there are fewer of these being built than there were a year ago. The number of engines going into central stations has been very small. Until there is an improvement in the financial condition of the country we cannot see any hope of any improvement in our business. We do think that there would be a considerable number of engines bought for electric light stations, should financial conditions be better. A great many from whom we have had inquiries write us that matters have been postponed until money matters are easier. If it were not for the isolated plants we would have to shut up our works. With these, however, we have managed to keep our force going, but on account of the small amount of business, the great competition and the desire of the buyer to buy cheap, the result has been that the builders of high-grade engines have been compelled to sell at such prices as will hardly allow them a new dollar for an old one. It is at present the 'survival of the fittest.'"

We learn from Beaudry & Co., Boston, Mass., that their sales of power hammers in March and April have been in excess of any previous month, and they think the prospects are that they will continue to have all the business they can comfortably handle. Their orders have not been confined to any particular class of manufacturers, but have come from carriage builders, the machine departments of cotton and other mills, machine builders and forge companies.

Quotations.

NEW YORK, Monday, May 11th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50@$13 25
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 00 @ 11 50
Gray Forge	11 25 @ 11 75
No. 1 foundry, Southern	11 75 @ 12 00
No. 2 foundry, Southern	11 25 @ 11 50
No. 3 Southern	10 75 @ 11 00
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, Southern	10 25 @ 10 50

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.20 @ 1.25c., perhaps 10 per cent. less for some qualities; refined, 1.25 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2⅛c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10¾c.; electrolytic, 10⅝ @ 10¾c.; casting copper, 10@10⅛c.

Pig Tin—For 5 and 10-ton lots, about 13.45 @ 13.50c., f. o. b.

Pig Lead—In carloads, 3.05c., f. o. b.

Spelter—In carload lots, New York delivery, quoted about 4.05 @ 4.10c., for common Western brands, though some spelter is offered as low as 4.00c.

Antimony—Cookson's, 7½ @ 7¾c.; Hallett's, 6.60 @ 6¾c.; Japanese, 6½ @ 6¾c.

Lard Oil—Prime city, present make, 47 @ 48c., in carload lots.

Manufactures.

The West End Electric Light Co., Hazleton, Pa., will erect a new plant.

Wm. H. Kemp, Hazleton, Pa., will erect a knitting mill and will put in machinery.

A laundry will be built at East Greenville, Pa.; E. A. Hendrick, manager. The building will be 60 x 100 feet. New machinery will be put in.

The W. F. & John Barnes Co., of Rockford, Ill., have added a four-story 100-foot addition to their factory to meet the increasing demands of their trade.

The Homer Steel Fence Co., capital stock $100,000, have been authorized to do business, and are about to build a 60 x 120 two-story factory at Battle Creek, Mich.

The Battle Creek, Mich., Steam Pump Co. have just finished a 60 x 140 foot enlargement to the machine shop and are now at work on an addition to the foundry, of the same size.

The city engineer has submitted an estimate to the council of the city of St. Thomas, Canada, for a combined electric light and electric railway plant for that city to cost $57,000.

George W. Glazier is building a 40 x 90 foot machine shop, two stories high, at Lynn, Mass. He will do a general machine business, but will make a specialty of morocco finishing machinery.

The Fifth Wheel Works—D. W. Wilcox, president and manager—Mechanicsburg, Pa., will erect a one-story iron-roof building 50 x 100 feet, and will put in a boiler, engine, drop hammers, etc.

It has now been finally settled that the market building and plaza of Newark, N. J., will be lighted with electricity. The light will be supplied by a new electric plant, built and owned by the city.

Solon D. and Harvey L. Bausher, under the name of Bausher Bros., will erect a factory at Harrisburg, Pa., for the manufacture of underwear. The plant will be equipped with engine, boiler and the most improved machinery.

The Goodyear Machine Company, of Boston, Mass., has decided to change its location to one outside the city. The location is not yet settled, and as they employ a large number of skilled employés, several cities are trying hard to secure the plant.

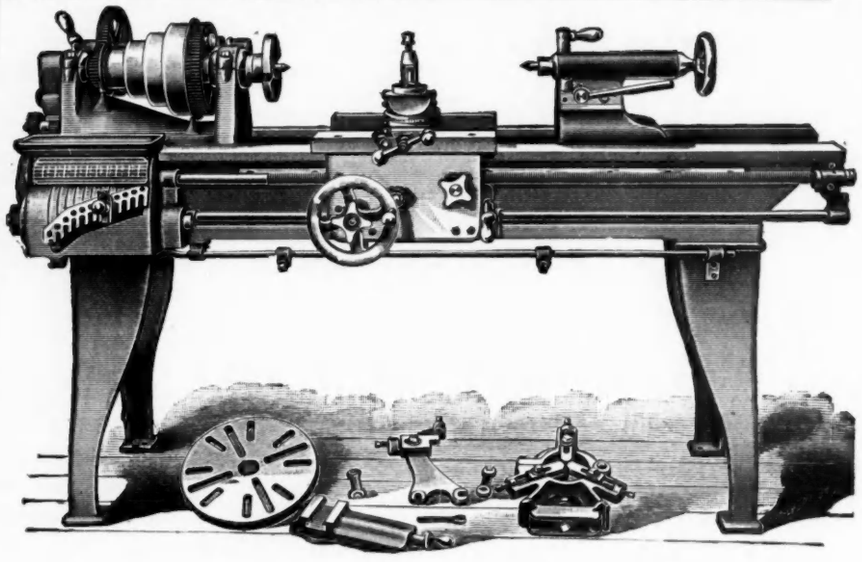
The Aetna-Standard mill, one of the largest sheet mills in the country, is preparing to build for themselves an immense steel plant, at Wheeling, W. Va. It will be located near their tin mills, and work, it is understood, is to be commenced as soon as the surveys are completed.

The old water privilege at Middleboro, Mass., known as the "Muttock Dam," and noted as being the site of the first rolling mill built in America, has been purchased as a power station for the Middleboro Street Railway. Mr. George Wood, of Middleboro, Mass., is interested in this branch of the work.

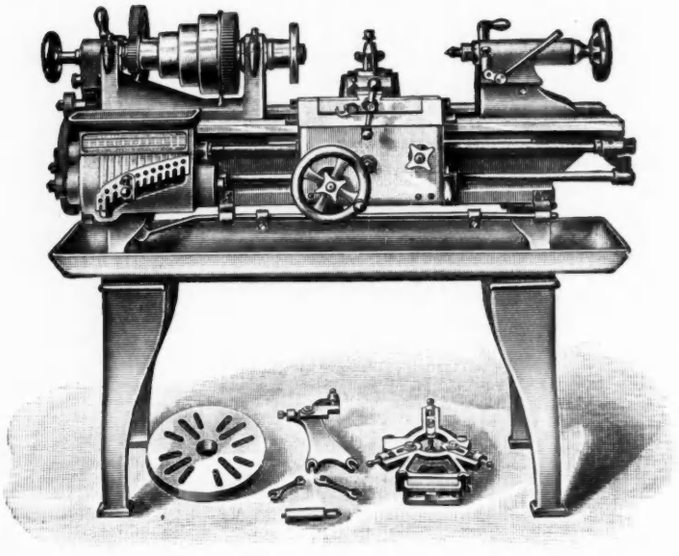
An electric trolley road is proposed from Battle Creek, Mich., to Kalamazoo, by the way of Augusta and Galesburg, with a spur to Gull Lake, a popular summer resort. E. E. Downes, manager of the electric lines at Battle Creek, is at the head of it, and it will undoubtedly go through this summer. The distance is 25 miles.

The Buffalo Forge Co. are building the special blowers with compound engines required for torpedo boats Nos. 3, 4 and 5, and also the Holland torpedo boats. The Columbia Iron Works, as is generally known, are building the above vessels for the United States Government. This house is also building the blowers and engines for revenue cutter No. 2, building by the Atlantic Iron Works, Boston, Mass.

The Geometric Drill Co., of New Haven, Conn., announce that they are about to remove to new and larger shops at 150 Ashmun street, and that Mr. H. E. Adt, who, for the past 15 years, has been connected with the firm of John Adt & Sons, New Haven, Conn., has lately become associated with their company, and will be in charge of the busi-



14-in. x 6 ft. Hendey-Norton Lathe, and 12-in. x 4 ft. Hendey-Norton Lathe. These are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear, and movement of lever in gear box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction. Invaluable for internal or duplicate work.



The 12-in. Lathe is fitted with drawing-in sleeve and American Watch Tool Co.'s Standard Chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterward. No centering required. See carriage reverse lever by right-hand side of apron; no reaching for countershaft shipper required.

SEND FOR CATALOGUE.

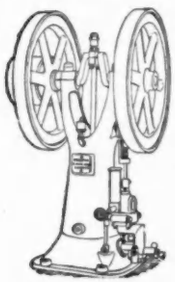
The Hendey Machine Co.,
TORRINGTON, CONN.

European Agents:
CHAS. CHURCHILL & CO., London, Eng.
SCHUCHARDT & SCHUTTE, Berlin, Germany.
EUGEN SOLLER, Basel, Switzerland.

'96 THE NEW '96 JENKINS '96

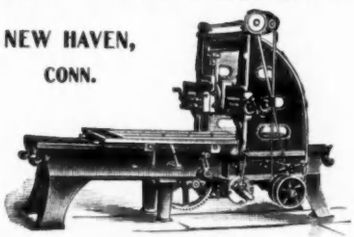
Is the Perfection of Joint Packing. Instantaneous, DOES NOT SQUEEZE OUT and not necessary to follow up joint. We guarantee it to last for years on any and all pressures of steam or any kind of joint where packing is required. Does not rot, burn or blow out, therefore the best for all purposes. Call for and insist on having '96 JENKINS '96, stamped like cut.

JENKINS BROTHERS, New York, Boston, Philadelphia, Chicago.



This beats Wind, Steam or Horse Power.
We offer the
WEBSTER 2 1-2 ACTUAL HORSEPOWER
GAS ENGINE
For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
Write for Special Catalog.
WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

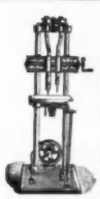
NEW HAVEN MFG. CO.
NEW HAVEN, CONN.



Manufacturers of
IRON WORKING MACHINERY.
Catalogue AC.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N. Y.
have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.
Thomas A. Edison

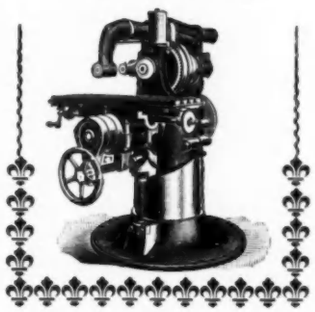
HIGH GRADE Metal-Working
PLANERS AND SHAPERS,
Write for circular and address of nearest agent.
THE OHIO MACHINE TOOL CO.,
600 South Leighton Street,
Kenton, Ohio.



Special Machinery.
Adjustable 2-Spindle Drill Presses
Cutter Grinders. Correspondence
Cock Grinders. Solicited.
Send for Photos or Blue-Prints.
FOOTE, BARKER & CO.,
49 "A" Wood St., Cleveland, O.

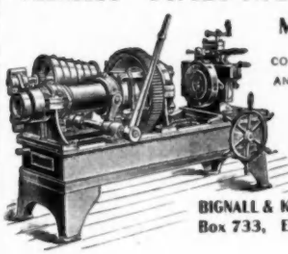
Patent Carrying Track
OVERHEAD TRAMWAY
for Mills, Foundries, Machine Shops, or for Merchandise. *Send for Book.*
The Coburn Trolley Track Mfg. Co.,
. . . HOLYOKE, MASS . . .

Plain Miller
Adapted to the requirements of the modern Railroad shop.

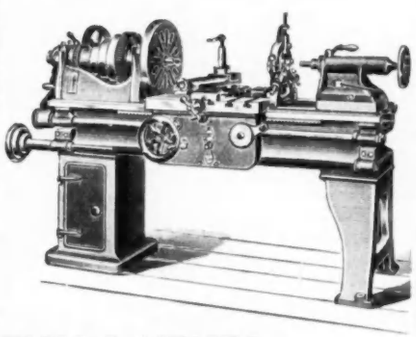


Description and Illustrations for the asking.
W. D. FORBES & CO.,
HOBOKEN, N.J., U.S.A.
1307 Hudson Street.

"PEERLESS" DUPLEX PIPE THREADING MACHINES.



COMBINATION BENCH AND PIPE VISES.
CONTINUOUS FEED RATCHET DRILL.
BIGNALL & KEELER MFG. CO.
Box 733, Edwardsville, Ill.



FISH LATHES ...
Formerly known as Prentiss Lathes.
▲ ▲ ▲
H. C. FISH MACHINE WORKS,
WORCESTEP, MASS.
Circulars on Application.

ness department, and will also assist in designing and perfecting special machinery.

It is now about settled that the New Castle, Pa., Steel & Tin Plate Company will build during the coming summer a fine steel plant. The managers and owners of the tin mill are thoroughly disgusted with the recent action of the steel manufacturers in raising the price of billets, and they claim that it will be impossible to run the works and compete with the old country tin manufacturers if the new price of steel billets prevails.

The Boston and Montana Consolidated Copper and Silver Mining Co., of Great Falls, Mont., are erecting a new electrical power house in connection with their large mining plant. This building is to be modern in all respects. The Berlin Iron Bridge Co., of East Berlin, Conn., have the contract for furn'shing the steel work. The building will be absolutely fire-proof, and the covering will be lined with Anti Condensation roof lining.

Messrs. Chas. S. Dundore, Thos. J. Dotts, Daniel J. Driscoll, Geo. H. Heckman and Henry C. England are the incorporators of a new enterprise for the manufacture of bicycles at Reading, Pa. The capital of the new company will be $50,000, and the new factory will be equipped with the latest machinery. It is probable that Mr. Dundore, who, until recently, was with the Dundore Cycle Company, will manage the new concern.

The Sawyer Tool Co., of Athol, Mass., are manufacturing a new line of bench levels, the frames of which are made of steel instead of cast iron, so that they are light to handle, have a finer finish, and will not break if accidentally dropped. They are accurately ground and adjusted, and nickel plated. For vertical work a glass is provided at each end of the level, so that it is always right for use whichever way it may be picked up.

The Niagara Falls Paper Co., Niagara Falls, N. Y., are going to make the following additions to their mill: A brick building, 170 x 150 feet, for the manufacture of sulphite fibre; grinder room, 98 x 69 feet; boiler house, 54 x 52 feet. They will also add the following new machinery: Five pulp grinders, 350 horse-power boiler capacity; 250 horse-power engine; wood conveyor, 650 feet long and 46 feet high; three water wheels, 1,300 horse-power.

The Sweet Manufacturing Company, of Syracuse, N. Y., has been reorganized with this list of officers: President, Robert Dey; secretary and treasurer, Francis H. Nye, Jr.; managing director, William A. Sweet. The other directors are George B. Leonard, Frank M. Bonta, Peter Eckel and Carl F. Banning, of New York. It is understood that the new company is investigating the question of bicycling tubing, and that the works may be put into the making of that kind of steel.

The Westinghouse Electric and Machine Company proposes to add two more shops to their mammoth plant at East Pittsburgh, Pa. Each will be 500 feet long and of the style of those already in operation. The new factories will be located on the site originally designed for extended improvements of their works. This site lies altogether within the limit of the borough of Turtle Creek. With these latter in operation, the number of Westinghouse Company's employés will be increased about 500.

The Pennsylvania Steel Company, Steelton, Pa., are working on a very large order for steel rails to be shipped to Brooklyn Heights, New Jersey. They are a new design of the girder rail, stand 9 inches and weigh 94 pounds to the yard. This company just made a large shipment of 58 pound T rails 60 feet long, to the Fitchburg Railroad in Massachusetts. These rails are the longest ever rolled at this plant. The company employ about 3,900 men and their last pay roll for two weeks amounted to almost $68,000, an increase over the same time last year.

The firm of C. H. Baush & Sons, of Holyoke, Mass., has been reorganized, and is now called the Baush & Harris Machine Tool Co. Mr. William A. Harris is the only new member of the new company, and all the members of the old firm remain with the new with the exception of the senior

member, Mr. C. H. Baush, whose death occurred January 7th. The company will remove to Springfield, Mass., as soon as a new plant can be erected, which, it is hoped, will be about July 15th. The new plant will be modern in every respect, and will largely increase present facilities.

The plans and specifications for the new electric light plant to be erected by the city of McKeesport, Pa., have been prepared by City Engineer F. W. Patterson. The City Controller will immediately advertise for bids for the construction and equipment of the plant. The building is to be 35 x 75 feet and will be fitted up with one non-condensing automatic engine of 300-horse power, and another of 125-horse power. There are to be two return tubular boilers, rated at 150-horse power; also three arc dynamos. The machinery is expected to produce 1,000 incandescent lights and 350 arc lights. The Councils of the city decided to erect a municipal plant because the only local company demanded a long contract at $75 per lamp.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The Ferracute Machine Co., Bridgeton, N. J., issue a special pamphlet devoted to presses built by them, particularly adapted to the manufacture of bicycles.

Wm. J. Baldwin, M. E., 277 Pearl street, New York, issues a finely-printed pamphlet on "The Separation of Grease from Exhaust Steam." Illustrations are given of Mr. Baldwin's separator for this purpose.

J. E. Snyder, Worcester, Mass., issues a new catalog devoted to his line of drilling machinery, which consists of upright drilling machines, ranging from 20 to 36 inches, plain and back geared, and with sliding heads. The catalog is standard size, 6 x 9 inches.

The Case School of Applied Mechanics, Cleveland, O., send us catalog of the mechanical engineering department, and in this we find illustrations of the equipment of the school in the way of machinery, tools, etc., with information regarding the course of study. It is 5½ x 8 inches.

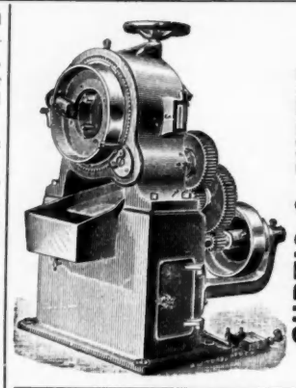
The Clarence E. Van Auken Co., Chicago, Ill., send us a finely gotten up catalog illustrating and describing their specialties to be used in connection with steam plants, and consisting of water columns, pressure regulators, pump governors and other appliances of that nature. The catalog is standard size, 6 x 9 inches.

The Replogle Governor Works, Akron, O., send catalog of water wheel governors, which are designed to automatically control the speed of water wheels, in such cases for instance as where water wheels are used for generating electricity and it is important that uniformity of speed should be maintained. The catalog is 8 x 5½ inches.

One of the finest trade catalogs recently issued is by A. L. Ide & Son, Springfield, Ill., and is devoted to setting forth the points of their Ideal High Art engines. The catalog has an embossed cover, and is illustrated by means of a number of fine engravings, showing the engine and some shop processes. It is standard size, 6 x 9 inches.

The L. S. Starrett Co., Athol, Mass., have issued a new catalog of tools and milling cutters. The catalog is attractively gotten up and illustrates a line of tools which are already quite familiar to most of our readers. In addition to the tool shown in former catalogs there are illustrations of a variety of milling cutters. The catalog is 5¼ x 7½ inches.

The American Stoker Co., Dayton, O., send an illustrated pamphlet in which is shown the construction of the American underfeed stoker, as



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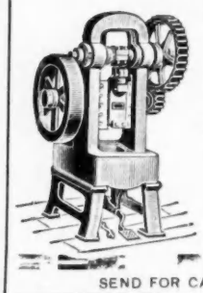

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applied to boilers, heating furnaces, kilns, etc. It is designed especially for the use of cheap bituminous coal in place of the more expensive fuels, and the coal is delivered to the grates automatically by the stoker. The pamphlet is standard size, 6 x 9 inches.

One of the most complete chuck catalogs that has been issued is by the D. E. Whiton Machine Co., New London, Conn., and contains numerous illustrations of a large variety of drill and lathe chucks, and diagrams are given accompanied by tables, by which full and complete information is given regarding sizes, capacity, varieties of jaws, etc. The catalog has 56 pages, and is standard size, 6 x 9 inches.

We have received from the Knickerbocker Engine Works, Hartford, Conn., a catalog illustrating and describing the new Knickerbocker engine, which seems to consist of four cylinders parallel, and all acting upon an oscillating plate, which is attached to the crank disc. The engine is designed to be used particularly for special high speed service, and where economy of space is important. The catalog is 5 x 8 inches.

D. Van Nostrand Co., of 23 Murray street, send us their newly revised catalog of books on electricity, electric light, electro-motors, etc. The books cataloged are classified—an arrangement which will be found of great convenience. This catalog forms Part 2 of a complete catalog of scientific and technical books which the publishers design issuing. The size is 5⅞ by 9¼ inches—so nearly standard as to be tantalizing.

The Webster Mfg. Co., Chicago, Ill., have issued a special catalog of the Webster upright gas and vapor engine No. 2. The catalog illustrates and describes various sizes and styles of this engine, and shows also adaptations of it to a variety of service, such as pumping, saws, roller mills, etc. Exterior and interior views of the shop in which it is built are given, and the catalog will be found interesting. It is 7¾ x 5¼ inches.

Dobbie, Stuart & Co., Niagara Falls, N. Y., send an illustrated catalog of contractor's and quarrymen's machinery, which consists of hoisting engines and machinery, portable boilers, windlasses and other hoisting and conveying machinery used by contractors. The catalog is accomplished by a letter in which the firm states it was their intention to have it 6 x 9 inches standard, but that the printer had actually made it 6⅛ x 9¼ inches.

E. W. Bliss Co., Brooklyn, N. Y., send us two pamphlets, one describing cutting and notching tools for armature disks and the other tools built by them which are especially adapted for use by bicycle manufacturers. These include drop-hammers and presses of various forms and sizes, some of which are specially adapted to special operations upon bicycle parts, such as chain-making, tube tapering, etc. The pamphlets are 5½ x 8½ inches.

Baker Bros., Toledo, O., issue a pamphlet which contains some realistic machine shop pictures illustrating the usual and also the improved methods of cutting key-ways in pulleys, gear wheels, etc. The pamphlet is called "A Bit of Ancient History, Illustrated; also A Glimpse of Modern Methods," and will be found interesting. It is standard size, 6 x 9 inches. They also send a complete catalog illustrating key-way cutting machines, which is also standard size.

The Hoppes Mfg. Co., Springfield, O., have issued a new and finely gotten up catalog, illustrating their live steam feed-water purifiers and exhaust feed-water heaters. The catalog shows not only complete purifiers and heaters, but also gives some very interesting illustrations of the evil results from using bad water in boilers without proper means of purification. The catalog will be found interesting, and is sent on application. It is standard size, 6 x 9 inches.

We have received a catalog of the Mergenthaler Linotype Co., Tribune Building, New York city, in which are given full illustrations and de-

scription of the Linotype machine, by which the type on this paper is set. The catalog also contains copies of a large number of letters written by users of it, and tables of figures giving the output of the machine in various printing offices, and comparisons with hand work. It is probably intended to be 6 x 9 inches, standard, but measures 5⅞ x 9⅛ inches.

The Pneumatic Engineering Co., of 100 Broadway, New York, have published two catalogs. One relates to their pneumatic hoist, which has several new features; while the second illustrates and describes their pneumatic systems of pumping, of which they have two. The Titus system is adapted for pumping from artesian wells, or wherever a deep submergence can be obtained, and the Halsey system is for pumping for all purposes where the submergence is small. The pamphlets are 6 x 9, standard, and will be found interesting.

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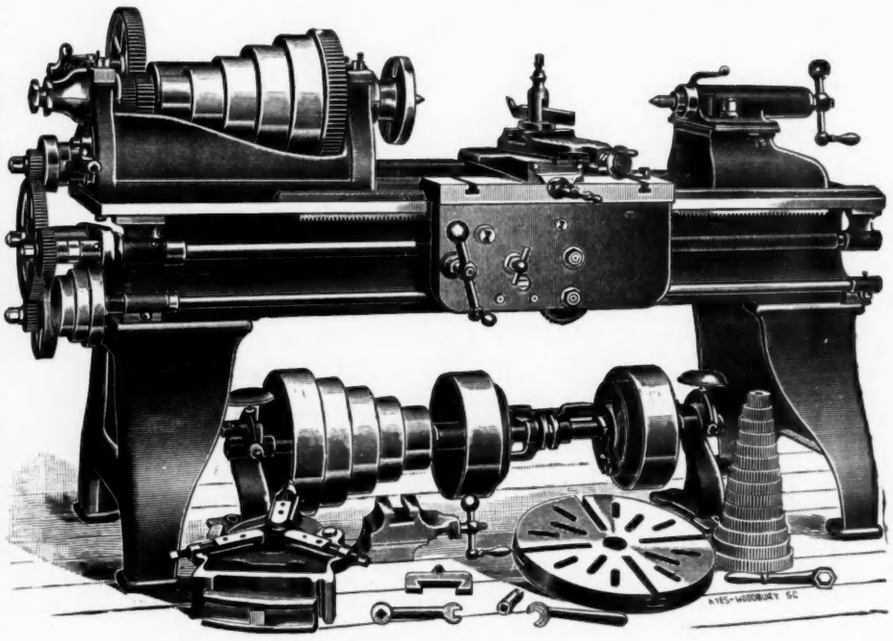

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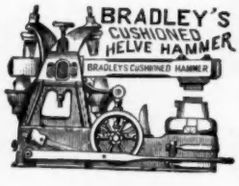

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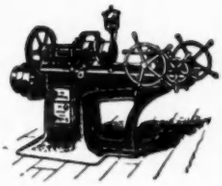

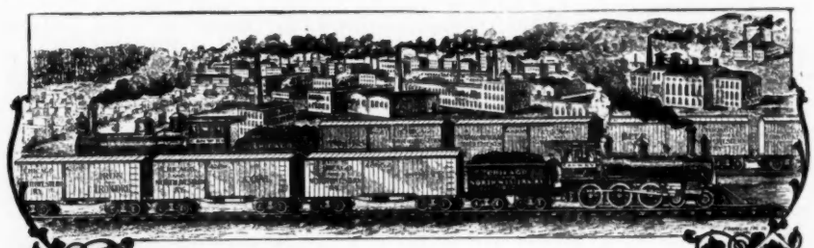

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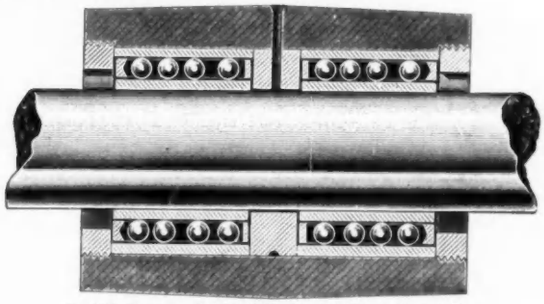

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Pratt Chuck Co.	35
Prentiss Tool & Supply Co.	30
Providence Line	24
Pryibil, P.	32
Quint, A. D.	38
Q. and C. Co.	33
Rand Drill Co	34
Reed Co., F. E.	26
Reece, Edw. J.	Cover
Reinecker, J. E.	37
Replogle Governor Works, The	24
Roots, P. H. & F. M.	Cover
Roth Bros. & Co.	34
Rutnagur & Co., M. C.	38
Sackmann, F. A.	37
Saunders' Sons, D	34
Sawyer Tool Co.	32
Sebastian Lathe Co.	26
Sebastian-May Co.	34
Sellers & Co., Inc., Wm.	Cover
Seneca Falls Mfg. Co.	30
Shriver & Co., T.	32
Skinner Chuck Co.	35
Slocomb & Co., J. T.	24
Springfield Gas Engine Co., The	40
Standard Tool Co.	38
Stark, John	37
Starrett, L. S.	37
Stiles & Fladd Press Co., The.	30
Sterling Emery Wheel Mfg. Co.	27
Stirling Co., The.	39
Strelinger & Co., Chas. A.	33
Sturtevant Co., B. F.	34
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Taylor-Rice Engineering Co.	29
Timolat, J. G.	39
Toledo Machine & Tool Co.	24
Toomey, Frank	29
Trump Bros. Machine Co.	32
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Warner & Swasey	Cover
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Waterbury Machine Co., The	39
W. & S. Hydraulic Machinery Works	Cover
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Webster & Perks Tool Co.	24
Wedderburn & Co., John	Cover
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Weston Engine Co.	40
Wetherill Machine Co., The James P.	37
Whitcomb Mfg. Co.	35
Whiton Machine Co., D. E.	35
Wiley & Sons, John.	25
Wiley & Russell Mfg. Co.	25
Wilkinson & Co., A. J.	33
Wilson, W. A.	30
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Worcester Polytechnic Institute	34
Wyke & Co., J.	30
Wyman & Gordon	Cover

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Guild & Garrison, Brooklyn, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

Anti-Friction Metal.
Passaic Smelting & Refining Co., Passaic, N. J.

Balls, Steel.
Cleveland Machine Screw Co., Cleveland, O.

Bearings, Anti-Friction.
Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg Mfg. Co., Attleboro, Mass.

Belting.
Akron Belting Co., The, Akron, O.

Belt Dressing.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Bench Screws.
Capital Machine Tool Co., Auburn, N. Y.

Bicycles.
Howard & Nichols Cycle Mfg. Co., Newark, N. J.

Bicycle Pumps.
Capital Machine Tool Co., Auburn, N. Y.

Bicycle Tools.
Bliss, E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Davis & Egan Mach. Tool Co., Cincinnati, O.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.

Blowers.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Cooke & Co., New York.
Roots, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston, Mass.

Boilers, Steam.
Orr & Sembower, Inc., Reading, Pa.
Sterling Co., The, Chicago, Ill.
Watts-Campbell Co., Newark, N. J.
Weston Engine Co., Painted Post, N. Y.

Bolt Cutters.
Acme Machinery Co., Cleveland, O.
Detrick & Harvey Machine Co., Baltimore, Md.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn
Reece, Edw. J., Greenfield, Mass
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich
Webster & Perks Tool Co., Springfield, O.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Books.
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Comstock, Wm. T., New York.
Grant, Geo. B., Lexington, Mass.
Henley & Co., Norman W., New York.
Philadelphia Book Co., Philadelphia, Pa.
Practical Publishing Co., East Orange, N. J.
Strelinger & Co., Chas. A., Detroit, Mich.
Van Nostrand, D., New York.
Wiley & Sons, John, New York.

Boring and Turning Mills.
Betts Machine Co., Wilmington, Del.
Bullard Machine Tool Co., Bridgeport, Conn.
Niles Tool Works Co., Hamilton, O.
Sellers & Co., Inc., William, Philadelphia, Pa.

Brass Work, Special.
Nolte Brass Co., Springfield, O.

Bushings.
New Process Raw Hide Co., Syracuse, N. Y.

Calipers.
Brown & Sharpe Mfg. Co., Providence, R. I.
Standard Tool Co., Athol, Mass.
Starrett, L. S., Athol, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Wilkinson & Co., A. J., Boston, Mass.

Castings, Brass.
Nolte Brass Co., Springfield, O.

Castings, Iron.
Builders Iron Foundry, Providence, R. I.
Burr & Houston Co., Brooklyn, N. Y.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Shriver & Co., T., New York.

Castings, Phosphor Bronze.
Nolte Brass Co., Springfield, O.

Castings, Steel.
Johnson Co., The, Johnstown, Pa.

(Continued on page 29.)

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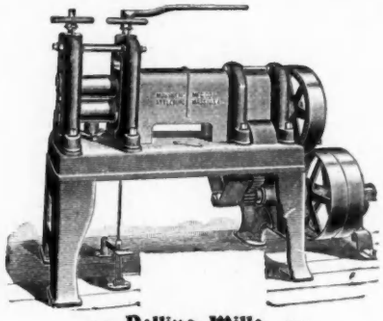

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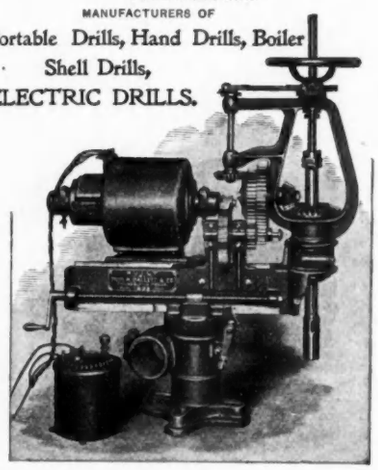

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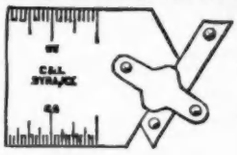

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10 in. x 4 ft., Reed.
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14 in. x 6 ft., Prentice.
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15 in. x 6 ft., Mansfield.
16 in. x 6 ft., Perkins.
18 in. x 8 ft., New Haven.
20 in. x 7 ft., Chamberlain.
20 in. x 8 ft., Pond.
20 in. x 15 ft., Pond.
22 in. x 12 ft., Perkins.
24 in. x 12 ft., Reed.
24 in. x 12 ft., Fitchburg.
26 in. x 10 ft., Lathe & Morse.
28 in. x 12 ft., Freeland.
32 in. x 16 ft., Waterman.
72 in. x 20 ft., triple geared.

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Sensitive, Barnes.
16 in., Aurora.
22 in., complete, Snyder.
24 in., complete, Ames.
25 in., complete, Blaisdell.
84 in., Radial, Betts.

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No. 2 Power, Pratt & Whitney.
No. 2 Power, Cincinnati.
Lincoln pattern, Pratt & Whitney.

PLANERS.

12 in. stroke, crank.
20 in. x 4 ft., Fitchburg.
20 in. x 5 ft., Hendey.
20 in. x 8 ft., Sellers.
22 in. x 5 ft., Pease.
24 in. x 6 ft., Pratt & Whitney.
26 in. x 6 ft., Whitcomb.
26 in. x 8 ft., Draper.
28 in. x 5 1-2 ft., Gage.
30 in. x 6 ft., Pease.
30 in. x 6 ft., Pond.
32 in. x 8 ft., Pond.
36 in. x 10 ft., Pond.
36 in. x 14 ft., Betts.
37 in. x 11 ft., Betts.
48 in. x 16 ft., Putnam.

SHAPERS.

16 in. stroke, Boynton.
10 in. stroke, crank, heavy.
15 in. stroke, Hendey.
16 in. stroke, Jeungst.
22 in. stroke, geared, Imp.
24 in. stroke, Hendey.
24 in. stroke, Walter.
10 in. Trav. head, Wood-Light.
13 in. " Warren.
14 in. " Fitchburg.
14 in. " Pratt & Whitney.

MISCELLANEOUS.

Stiles Presses Nos. 2-3.
Gould-Eber. 36 in. Gear Cutter.
Up. B. & T. Mill., 40 in.
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Boiler Punch, 22 in.
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Steam Hammers, 350-2,500 lbs.

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29 in. x 13½ ft. Engine Lathe.
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37 " 30 " " "
51 " 18 " " "
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Portable Drill.
36 in. x 14 ft. Planer.
12 in. Shaper Traverse Head.
Gear Cutter, 54 in.
Milling Machine.
Cranes, Blower.

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GEORGE PLACE MACHINE CO.
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14 in. x 6 ft., Prentice Bros.
14 in. x 6 ft., Jones & Lamson.
15 in. x 6 ft., Porter Machine Works.
16 in. x 6 ft., Blaisdell.
16 in. x 6 ft., Dexter Machine Works.
16 in. x 6 ft., Lodge & Davis.
16 in. x 8 ft., Fitchburg.
18 in. 10 ft., Blaisdell.
18 in. x 10 ft., Flather & Co.
18 in. x 6 ft., Bradford.
21 in. x 8 ft., Lodge & Davis.
22 in. x 8 ft., Blaisdell.
26 in. x 16 ft., Jones & Lamson.
34 in. x 20 ft., F. S. Perkins.

PLANERS.

17 in., Whitcomb, crank.
16 in. x 16 in. x 3 ft., Pratt & Whitney.
24 in. x 24 in. x 5 ft., Gray.
24 in. x 24 in. x 8 ft., Fitchburg.
26 in. x 26 in. x 6 ft., D.W. Pond.
22 in. x 22 in. x 5 ft., Pease.

SHAPERS.

6 in., Boynton & Plummer, for hand.
10 in., Hewes & Phillips, crank.
10 in., Juengst, crank.
13 in., Hendey, friction.
15 in., Lodge & Davis, crank.
15 in., Smith & Mills, crank.
15 in., Chase, crank.
16 in., Gould & Eberhardt.

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1-Spindle Garvin Profiler.
25 in. Pond Drill Press.
No. 2 4-Spindle Pratt & Whitney Drill.
No. 20 Hibbard Power Press.
No. 2 Pratt & Whitney Automatic Bolt Cutter.
No. 2 Garvin Automatic Gear Cutter.
21 in. Prentice Drill Press.
No. 1 Garvin Lincoln Miller.
No. 3 Garvin Lincoln Miller.
Prentice Bros. Suspension Drill.
No. 1 Pratt & Whitney Screw Machine.
No. 13 Brown & Sharpe Screw Machine.
No. 2 Springfield Tool Grinder.
No. 2 Garvin 3-Spindle Drill.
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No. 2 Diamond Polishing Lathe.
3 in. Armstrong Pipe Machine.
26 in. New Haven Drill.

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Second-Hand Machinery.

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1 12 in. x 5 ft., Young.
1 13 in. x 5 ft., Lathe & Morse.
1 No. 39 S., 14 in. x 5 ft. 6 in. Harris.
1 No. 38 S., 18 in. x 6 in., Harris.
1 15 in. x 6 ft., Blaisdell.
1 15 in. x 6 ft., P. & W.
1 No. 18 C., 18 in. x 6 ft., L. & D., Compound Rest & Taper Attachment.
1 No. 19 C., 18 in. x 6 ft., L. & D., Compound Rest & Taper Attachment.
1 No. 20 C., 18 in. x 6 ft., L. & D., Compound Rest & Taper Attachment.
1 19 in. x 6 ft., Heavy F.
2 20 in. x 11 ft., Lathe & Morse.
1 No. 37 S., 20 in. x 10 ft., Lincoln.
1 No. 3 C., 21 in. x 10 ft., P. & W., Taper.
1 No. 6 C., 22 in. x 9 ft., P. & W., Taper.
1 No. 5 C., 22 in. x 10 ft., Niles, Taper.
1 No. 25 S., 23 in. x 10 ft., J. D. White, Taper.
1 24 in. x 16 ft., Nicholson & Waterman.
1 26 in. x 10 ft., Dustin & Hubbard.
1 No. 49 S., 27 in. x 12 ft., Wood & Light.
1 No. 50 S., 28 in. x 12 ft., Wood & Light.
1 No. 9 S., 28 in. x 18 ft., Wood & Light.
1 30 in. x 12 ft., Lathe & Morse new.
1 No. 44 S., 30 in. x 14 ft., Lincoln.
1 No. 45 S., 32 in. x 13 ft., Bement & Dougherty.
1 No. 46 S., 36 in. x 12 ft., Lincoln.
1 No. 19 S., 40 in. x 16 ft., Wood & Light.
1 No. 61 S., 48 in. x 18 ft., Gay & Silver.

PLANERS.

1 B., 20 in. x 20 in. x 4 ft., Fitchburg.
1 No. 10 S., 24 in. x 24 in. x 4 ft., Wood & Light.
1 No. 11 S., 24 in. x 24 in. x 4 ft., Wood & Light.
1 No. B., 24 in. x 24 in. x 4 ft., Pond. Mch. Tool Co.
1 No. B., 24 in. x 24 in. x 4 ft., Pond. Mch. Tool Co.
1 No. B., 24 in. x 24 in. x 5 ft., Pond. Mch. Tool Co.
1 No. 81 S., 24 in. x 24 in. x 5 ft. 6 in., Wood & Light.
1 H., 24 in. x 24 in. x 6 ft., Lathe & Morse.
1 No. B., 26 in. x 26 in. x 6 ft., Pond. Mch. Tool Co.
1 No. 16 S., 28 in. x 28 in. x 8 ft., Gay & Silver, Heavy.
1 No. 14 S., 32 in. x 32 in. x 10 ft., Wood & Light.
1 No. B., 36 in. x 36 in. x 9 ft., New Haven.
1 No. P., 36 in. x 36 in. x 9 ft., English.
1 No. B., 36 in. x 36. in. x 10 ft. Pond Mch. Tool Co.
1 No. P., 36 in. x 36 in. x 14 ft., Powell.
1 No. 13 S., 38 in. x 38 in. x 10 ft., Aldrich & Co.
1 No. 17 S., 32 in. x 10 ft., Van Horn, Open Side Planer.
1 No. 127 C., 48 in. x 32 in. x 8 ft., Pond. Mch. Tool Co., 2 heads.
1 No. 128 C., 48 in. x 32 in. x 6 ft., Pond. Mch. Tool Co., 2 heads.
1 No. 129 C., 48 in. x 32 in. x 6 ft., Pond. Mch. Tool Co. 2 heads.
1 No. 130 C., 48 in. x 32 in. x 6 ft., Pond. Mch. Tool Co., 2 heads.
1 No. H., 60 in. x 60 in. x 15 ft., Niles Tool Works Co., 3 Heads.
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Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Trump Bros. Machine Co., Wilmington, Del.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Whiton Machine Co., D. E., New London, Conn.

Chucks, Lathe.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Chuck Co., New York.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Clayville, N. Y.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London, Conn.

Chucks, Tapping.
National Chuck Co., New York.

Clutches, Friction.
Evans Friction Cone Co., Boston, Mass.
New Haven Mfg. Co., New Haven, Conn.

Computers.
Cox Computer Co., New York.

Condensers.
Conover Mfg. Co., New York.
Guild & Garrison, Brooklyn, N. Y.

Counting Machines.
Durant, W. N., Milwaukee, Wis.

Cranes.
Maris Bros., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Cutting-Off Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., So. Sudbury, Mass.

Damper Regulators.
Hine & Robertson Co., New York.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter, J. M., Pawtucket, R. I.
Detrick & Harvey Machine Co., Baltimore, Md.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drawing Instruments, Etc.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drilling Compound.
Peerless Drilling Compound Co., The, Utica, N. Y.

Drilling Machines.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Foot, Barker & Co., Cleveland, O.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Quint, A. D., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drill Gage.
Wyke & Co., J., East Boston, Mass.

Drill Rods.
Abbott, Wheelock & Co., Boston, Mass.

Drills, Twist.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Drop Forgings.
Wyman & Gordon, Worcester, Mass.

Continued on page 30.

BUYERS' FINDING LIST—Continued.

Dynamos.
Roth Bros. & Co., Chicago, Ill.

Elevators.
Albro-Clem Elevator Co., Philadelphia, Pa.

Emery Wheels.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Sterling Emery Wheel Co., Tiffin, O.

Engines, Gas and Gasoline.
Norman Co., J. J., Chicago, Ill.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Springfield Gas Engine Co., Springfield, O.
Webster Manufacturing Co., Chicago, Ill.

Engines, Steam.
Ames Iron Works, Oswego, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Keystone Engine & Mach. Works, Phila., Pa.
Orr & Sembower, Inc., Reading, Pa.
Watts-Campbell Co., Newark, N. J.
Weston Engine Co., Painted Post, N. Y.
Wetherill Machine Co., James P., Chester, Pa.

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Hine & Robertson Co., New York.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

Files.
Besly & Co., Chas. H., Chicago, Ill.
Machinists' Supply Co., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Strelinger & Co., Chas. A., Detroit, Mich.

Forges.
Buffalo Forge Co., Buffalo, N. Y.
Wilkinson Co., The, Chicago, Ill.

Friction Cones.
Evans Friction Cone Co., Boston, Mass.

Furnaces.
American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

Gages.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wyke & Co., J., East Boston, Mass.

Gear Cutters.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant, Geo. B., Lexington, Mass.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn.

Gears.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant, Geo. B., Lexington, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

Governors.
Replogle Governor Works, The, Akron, O.

Graphite.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grinders, Center.
Barker & Co., William, Cincinnati, O.
Leland & Faulconer Mfg. Co., Detroit, Mich.
Trump Bros. Machine Co., Wilmington, Del.

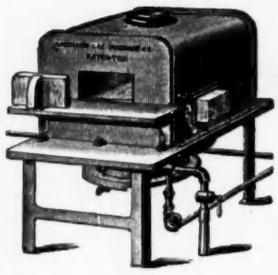
Grinding Machines, Universal.
Brown & Sharpe Mfg. Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

Grinding and Polishing Machines.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
Norton Emery Wheel Co., Worcester, Mass.
Place Machine Co., George, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.

Grinding Machine, Cock.
Foote, Barker & Co., Cleveland, O.

Grinding Machine, Cutter.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Foote, Barker & Co., Cleveland, O.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Continued on page 31.



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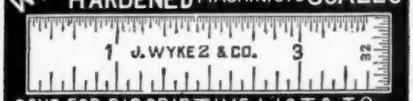

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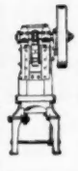

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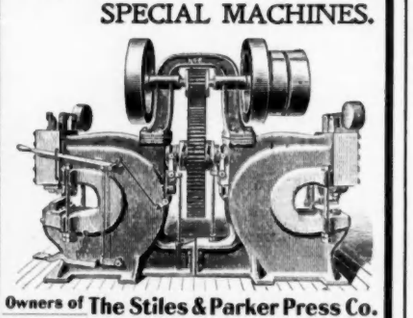

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